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Practical and Theoretical Mechanics and Chemistry.

Observations on Dr. Gries' Mode of introducing Air for heating Apartments. By R. Hare, M. D. *Professor of Chemistry in the University of Pennsylvania.*

To the Editor of the Journal of the Franklin Institute.

Sir.—In an article in the number of your Journal for August last, Dr. Gries urges that in conveying hot air into apartments for the purpose of warming them, it is expedient to have it enter near or through the floor. He anticipates that his views will not be considered as new, but presumes that if the course which he recommends has been pursued before, it has been through *mere accident where it happened to be the most convenient arrangement, and not upon any well understood principle.*

The opinion expressed by Dr. Gries, has been long entertained, and acted upon by me; and in my lecture room, has been verified during ten years past. This must be sufficiently evident from the following paragraph in a description of my laboratory, which was published with a former edition of my text book, and republished in Silliman's Journal and the London Philosophical Magazine and Journal.

"The laboratory is heated by stoves under the arches beneath the hearth; of which one is included in a chamber of brick work. The chamber receives a supply of fresh air through a flue terminating in an aperture in the external wall of the building; and the air, after being heated, passes into the laboratory at fifteen apertures, distributed over a space of thirty feet. Twelve of these apertures are in front of the table, being four inches square, covered by sheet iron full of holes. In the hearth there is one large aperture of about twelve by eighteen covered by a cast iron plate, replete with perforations. Two other apertures for the admission of the hot air are under the table. By these means the air heated by the stove is, at its entrance, so much diluted with the air of the room, that an unusually equable temperature is produced; there being rarely a difference of more than two degrees of Fahrenheit, between the temperature in the upper and in the lower part of the lecture room."

Agreeably to the expedient described in the passage above quoted the currents of air entering through nearly 500 perforations, are so intermingled with the comparatively cool air of the room as to prevent the tendency to rise which Dr. Gries justly deprecates as tending to transfer the air to the upper portion of the room.

I beg leave to assure Dr. Gries that this arrangement was adopted after reflection, and upon principles which I supposed myself to understand; and which I have endeavoured to explain to my class during my course of lectures for many years. An engraving and description of my lecture room were attached to a former edition of my text book in which the peculiarity to which I have alluded was mentioned.

"I will take this opportunity of stating that the air received as above mentioned is supplied from a chamber in the cellar of about 12 feet square, heated by an anthracite stove; and that I consider it highly advantageous to have a cavity for the stove of these unusually large dimensions and also an ample influx of fresh air from the exterior of the building through a flue, or a trunk, provided for the purpose."

Evidently an equal rise in the temperature of an apartment may be effected by a small mass of air intensely heated, or a large mass moderately heated; the quantity being inversely as the temperatures: but in the one case, the particles of vegetable or animal matter which are always floating in the atmosphere are not liable to be decomposed, while, in the other case, their decomposition ensuing in consequence of the undue heat, is productive of that unpleasant effluvium which characterizes stove rooms. The warmth imparted to the air of my lecture room, is like that which results from a change in the weather; it has no attribute which would lead an observer to suppose it to arise from a stove, or from a culinary fire of any kind.

I will also take this opportunity of mentioning, that at first I found a great difficulty in getting cast iron to withstand the long continued and occasionally intense heat of an anthracite fire, as supported in stoves employed to heat chambers as above mentioned. Agreeably to my subsequent experience this difficulty may be surmounted by employing a comparatively large cylinder for the fire place, with a grate of about half the diameter. By these means the heat being chiefly in a vertical column, of which the grate forms the base, a thickness of several inches of fuel in a comparatively low state of ignition, is interposed between the iron and the hottest part of the fire. The coal in fact serves as a lining to the iron. The diameter of the cylinders which I use is at bottom twenty inches, while that of the grates associated with them is only eleven inches.

Though the term cylinder is employed, the casting to which it is applied is really a hollow conical frustrum about two inches less in diameter at the upper end, than at the base. This lessens the weight of metal and yet answers at least as well as if the shape were that of a true cylinder, because the upper half is less exposed to the fire than the lower.

Notice of advances made in the Science of Mineralogy during the year 1837. *From the Report of Berzelius to the Swedish Academy.*

Berzelius' "Annual Report" to the Swedish Academy "of the progress of the Physical Sciences," presents us with a very full account of the advances made during the year preceding that in which it is published, and although treating in some measure of them all, is more valuable to the

chemist and mineralogist from the accompanying notes of the learned author on the subjects respectively described. Through the medium of French and English Journals, we are put in possession of many of the observations and discoveries of continental philosophers in all branches of the physical sciences excepting in mineralogy; and believing that among the large number of subscribers to this Journal there are many who would feel an interest in the progress of the latter science, the mineralogical committee of the Institute propose making free translations from Berzelius' work, by noticing the advances made in the science during the year 1837, the account of which was handed in to the Swedish Academy in the Spring of 1838, and was published in Germany in the early part of the present year.

COM. MINERALOGY.

BABINET (Pogg. An. XLI. 115,) examined the optical characters of minerals and their utility, and comprehended them under six divisions; 1st, absorption of light without polarization or refraction; 2nd, absorption with polarization; 3rd, dichroïsm and polychroïsm; 4th, appearances analogous to lunar rings, &c.; 5th, a star or analogous phenomena; 6th, chromatic polarization (crosses and black lines with surrounding rings.) This performance appears to possess great interest, in illustrating the theory of refraction of light in different bodies with a cristalline texture, less, however, for facilitating the means of recognizing minerals.

VON KOBELL* projected a scale of the fusibility of minerals as an additional means of distinguishing them before the blow-pipe. He selected the following of increasingly difficult fusibility.

1. Sulphuret of antimony.
2. Natrolite or mesotype.
3. Almandine or precious garnet.
4. Actynolite or light green hornblende.
5. Adularia or orthoclase.
6. Diallage.†

Fine splinters of these minerals are compared with similar ones of the mineral to be examined, and the fusibility expressed by one of the six numbers, annexing a decimal number to give the exact grade between that and the next higher number. Thus the capability of fusion of Hypersthene is expressed by 5.5; that of Datholite from 1.8 to 2, that is, it is nearly as fusible as natrolite. These examinations cannot attain great accuracy, but will be of value in connection with other experiments with the blow-pipe.

BREITHAUPT,‡ in continuing his determination of the specific gravity of minerals, has given that of ninety-eight species, and has farther compared that of fourteen from different localities which have been viewed as pitchblende.

SUCKOW§ has described a reflecting goniometer the results of measurement with which do not depend on the evenness of the surfaces, and give the inclination of both brilliant and dull surfaces towards each other.

New Minerals.

Protoxide of Palladium.—The palladiferous gold from the mines of Gorgo Soco in Brazil, is coated with ochreous matter precisely similar to hydrated

* Journal für practische Chemie x, 258.
† It is not known which kind is referred to. *Tr.*
‡ Journal f. pract. Chemie, x; 151.
§ Ibid. 158.

peroxide of iron, which Johnson found to contain protoxide of palladium. This statement has been confirmed by Lampadius,* who found that 109 grains of the metallic particles, with their oxidized coating were resolved into 40.7 grains of gold containing palladium, and 59.3 grains which dissolved in the hydrochloric acid. Ammonia gave a yellow precipitate, soluble in an excess of the precipitant, and from the filtered solution, cyanid of mercury threw down palladium.

Breithaupt† has described the following seven new minerals.

Peroxide of Lead, (Schwarzbleierz,) from an unknown locality supposed to be *lead hills*, forms a scaly mass, surrounded with carbonate, phosphate and sulphate of lead. The color is black, with a brown streak; the mass compact, enclosing crystaline particles; fracture uneven; brittle. Sp. gr. 9.332 to 9.448. Before the blow-pipe it first yields oxide of lead and then a metallic globule of the same metal.

Copper-blue, from the mine Herren Seegen, in Schoppachthal in Baden, is a hydrated silicate of peroxide of copper with alumina and oxide of iron. Color sky-blue; streak, smalt-blue, shining, brittle, adhesive to the tongue. Color improved by water, which renders it translucent. Sp. gr. 2.56.

Malthacite (from μαλθακος, fat, which it resembles,) was found by Törmer among disintegrated blocks of basalt near Steindörfel, between Löbau and Baudissin. Color white with yellowish tinge; faint waxy lustre; translucent; forms thin plates, rarely in mass; uneven, conchoidal fracture, easily severed; greasy to the touch; falls to pieces in water. Sp. gr. 1.996 to 2.01. It consists, according to an analysis of O. Meissner, of

Silica,	50.2
Alumina,	10.7
Lime,	0.2
Oxide of iron,	3.1
Water,	35.8,

approaching to the formula $F S^4 + 3 A S^4 + 5$ aqua. Decrepitates before the blow-pipe, gives water, but does not melt.

Variscile (from Variscia, the Latin name of Voigtland,) occurs with quartz near Messbach in Saxon Voigtland. It is a hydrated phosphate of alumina, oxides of iron and chrome, magnesia and ammonia. Color apple-green, streak white, waxy and glistening; translucent; in a kidney-form mass; conchoidal, somewhat uneven fracture; separates easily; greasy to the touch. Sp. gr. 2.345 to 2.378. Before the blow-pipe gives an ammoniacal water and assumes a rose-color, is infusible at a higher temperature and becomes colorless; the chrome reaction is not distinctly produced by the fluxes; borax-glass may be rendered cloudy by flaming.

Lavendulan is an arseniate of cobalt adulterated by arseniate of nickel and copper, occurring in the Erzgebirge near Annaberg, in the mine Galilæische Wirthschaft. Color lavender-blue; lustre between waxy and vitreous; translucent; kidney-form; conchoidal fracture; easily severed into shelly separations. Sp. gr. 3.014. Before the blow-pipe yields water, exfoliates, becomes bluish gray, and loses its cohesion; easily fuses in the pincette, and is surrounded with a blue flame; the bead crystalizes on cooling, like phosphate of lead, but becomes black; some show a dark hyacinth red color. On charcoal, it emits fumes of arsenic, and is reduced to an arseniuret.

* Journal für practische Chemie xi, 311.
† Do. do. x, 501.

The borax-glass is slightly tinged with cobalt, which is singular enough if cobalt is the principal constituent.

Diadochite (from διαδοχαω, to replace another, because it is an iron-sinter (pharmacosiderite) in which phosphoric acid wholly replaces the arsenic acid,) occurs in the alum-slate quarry of Arnsbach, near Schmiedefeld in Saalfeld. Color dark wax-yellow, passing into brown; lustre between waxy and vitreous; streak colorless, slightly translucent; is kidney-form or stalactitic; fracture conchoidal, easily severed. Sp. gr. 2.035 to 2.037; contains 36½ pr. ct. water, a trace of sulphuric, but no arsenic, acid, and is a hydrated per-phosphate of iron.

Symplesite (from συμπλησιαζειν, to have nearer neighbors,) is an arseniate of iron of unusual color, the well known green compound of a proto and per-salt, communicating to this mineral a bluish color. It occurs in the iron mines of Lobenstein in Voightland. Color pale indigo-blue, sometimes between this color and celadon-green, rarely between mountain and leek-green, and then only superficially; forms flat, needle-shaped crystals, which exhibit a pearly lustre on the more perfect planes; translucent to semitransparent. Sp. gr.= 2.957. It contains 25 to 26 pr. ct. water, becomes brown by ignition, emitting an arsenical odor, and ignited on charcoal becomes black and magnetic. Beside the proto and per-arseniate of iron, it probably derives its bluish tinge from phosphate of iron.

After reading descriptions of minerals similar to those given above, it is impossible to withhold the remark that there are many industrious mineralogists who study the physical characters of minerals too much in minute detail, make their classification, and give names accordingly, and are nevertheless at fault in solving with accuracy the main question as to what the mineral really is. The time will, however, come when mineralogists will consider the main question to be the determination of the composition of a mineral. The assertion of Mohs, that no part of chemistry belongs to mineralogy, (on which Cuvier properly remarked, "qu'il a fait reculer la science") will probably expire with non-chemical mineralogy, for it would otherwise be no true science, and until that period arrive, its descriptions will resemble the marks on a package of unknown goods.

A. F. Svanberg and C. Tenger presented to the Museum of the Academy of Sciences a new mineral found by them in the felspar quarry of Ytterby. It is carbonate of yttria. It generally occurs as a thin, white coating, which has latterly been observed in the fissures of gadolinite. But it is now found on another mineral, and in such quantities as to allow of a chemical examination. In a few instances, they thought it exhibited signs of a fibrous, crystaline structure.

In a succeeding number we shall notice new examinations of minerals formerly known, either by full translations or extracts from the Jahresbericht of Berzelius, of which we have above offered an example.

Com. Min.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1838,

With Remarks and Exemplifications by the Editor.

1. For a *Crane for Loading and Discharging Vessels*; Thomas Goodwin, city of New York, October 2.

A vertical shaft is to be placed on board a vessel, or on a wharf, &c.

The lower end of this shaft is round, and it is made to revolve, holes being pierced through the deck, if placed on board a vessel, to receive it. Two gibs furnished with pulleys at their upper ends project from opposite sides of the vertical shaft, and these may either be fixed, or raised and lowered by guyes. The rope by which the goods are to be hoisted and lowered passes over the pulleys at the upper ends of the gibs, descending thence between them to a drum, or barrel fixed in the shaft at a proper height to be turned by a winch; round this drum the rope takes two or three turns. By turning the drum, barrels, or packages of any kind, may be raised by one end of the rope, and lowered by the other, and so on alternately. When the goods are suspended the crane is to be slued round, so as to deposit the package on a wharf, or on board of another vessel.

The claim is to a crane of the foregoing construction, "for hoisting and lowering weights, so that two weights, one to be raised, and the other to be lowered, shall, in whole or in part, be made to counterpoise each other, substantially in the manner above set forth."

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2. For *Laying off and Dressing the Runner of Mill Stones;* Charles Vest, Stokes county, North Carolina, October 2.

Four of the lands on the runner are to be laid out with a particular curvature towards the centre of the stone, and the intermediate furrows are also to be made of a length, and in a manner, designated, which the patentee says will cause the stones to work better than in the old way; and the claims are to this mode of laying out. Perhaps the plan may possess all the virtues ascribed to it, but not being very sure of this we do not think it necessary to describe it more particularly.

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3. For an improved *Cultivator and Weeder;* Simeon M. Marshall and Joseph W. Coburn, Dracut, Middlesex county, Massachusetts, October 3.

This cultivator has two handles, of the ordinary form, and teeth, or hoes, which are also similar to others; its peculiarity consists in its running on two wheels, one behind the other. A wheel of about two feet in diameter is situated about the centre of the machine, and another twelve or fourteen inches in diameter, in front. The particular use or object of this arrangement is not stated, and the claim is to "the frame in which the wheels work, constructed and operating as above described, in combination with the weeding harrow," &c.

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4. For an improved *Level and Plumb;* Lemuel Lewis, Newfield, Tompkins county, New York, October 3.

This instrument is denominated "the balance and pendulum level and plumb." The indications are to be made by means of levers, or rods, inserted in a piece of wood, which may be two feet long, two inches broad, and an inch and a half high. The level indicator is a bar of iron hung on pivots at its centre. It is examined through a small pane of glass covering its end, allowing the mark to be seen by which its position is ascertained. The plumb indicator is hung like a pendulum, at a suitable distance from its pointed end; its opposite end being weighted to act as a pendulum. It is inspected in the same way with the level.

The claim is to "the so hanging the level and plumb, on pivots, in the

box or case, as to have them indicate the true level and perpendicular, by pointing to marks on the brass plates at the ends, as above described."

5. For a metallic *Napper for Napping Cloth;* John M. Pratt, Dudley, Worcester county, Massachusetts, October 3.

This machine is said to be an improvement on Hurd's patent Metallic Napper. The metallic points which are substituted for teazles are to be soldered to a strip of tin, or other thin metal, which will possess elasticity, instead of being confined to an unyielding piece, as in Hurd's. These points stand in rows along the napping cylinders, and between each row there is a gauge, consisting of a strip of wood, or of metal, which is capable of adjustment, so as to regulate the action of the points upon the cloth. The claims are to "the mode described of fastening and forming the points or pins into flats so as to preserve their elasticity, and give them play between the gauges; and the mode of regulating the gauges so as to equalize and perfect the operation of napping."

6. For an *Ice Boat;* Jacob Townsend and Walter Hunt, city of New York, October 3.

Across, and in advance of, the bows of the boat there is to be a revolving cylinder, driven by a chain band actuated by the paddle wheel; this cylinder is to act upon the ice, being guided by suitable arms, and is furnished with teeth or spurs on its outer surface, by which the ice is to be broken. The claim is to the foregoing arrangement; in which there certainly is no more of novelty than was necessary upon a liberal construction of the claims to secure a patent. We do not know whether time and experiment have told the tale of its utility, but are very apprehensive that their report will not be of a character to gratify the inventors.

7. For a *Hill Side Plough;* Isaac Teeter, Johnstown, Pennsylvania, October 3.

This patent is taken for the particular manner devised by the patentee for tilting the mould board from side to side, and the fastening it in place so as to cause it to throw the furrow alternately in opposite directions.

8. For an improvement in *Fire Arms;* Samuel Adams, Springfield, Hampden county, Massachusetts, October 3.

The main object of this invention is said to be the combining in the same barrel, a rifle and a smooth bored gun. The gun is to be of that kind which receives its loading at the breech, by the insertion of a metallic cartridge into a smooth bored gun. When it is desired to convert this gun into a rifle, a barrel is to be inserted at the breech, which will fill the bore of the smooth gun, and project beyond its muzzle, where it is to be drawn up and secured by a screw ferule. A projecting rim on the rear end, is at the same time drawn against the shoulder on which the metallic cartridge was received. When used as a rifle, a movable sight is to be brought into action.

Claim.—"What I claim as my invention is the combining of one barrel within the other, in manner, and for the purposes herein set forth and described. I also claim the making the back sight of a rifle to turn on a pivot, in manner, and for the purpose set forth.'

We very much doubt whether the manufacturing of combined guns upon the above plan, will ever be carried to an extent which will enable the

patentee to repay the cost of a patent, as it seems to be one of those whimsies which may afford personal gratification to an individual, but is not likely to come into extended use.

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9. For *Elliptical Springs for Carriages;* George B. Robinson, Pawlet, Rutland county, Vermont, October 3.

The manner of combining elliptical springs for carriages has undergone numerous modifications, which within a few months, have been made the subject of patents, some of these are undoubtedly real improvements, whilst others are mere variations in the mode of connecting and combining the parts. The spring before us consists of a double pair of elliptic springs, one placed immediately above the other, and each having a sliding groove through which a pin passes, confined by a nut, or button, to allow of lateral play to the ends of the springs, they being divided where they bear upon each other.

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10. For a machine for *Picking Oakum, Curled Hair, &c.;* Hiram Burnham, Boston, Massachusetts, October 5.

The picking is to be effected between toothed cylinders, and the invention of any of the particular parts of which the machine consists, is disclaimed, the claim being confined to "the arrangements of the whole, and their combination together, forming a machine for the purpose herein above specified."

It is very rarely that a claim like the foregoing is allowed to pass in the office, it being in general required that the substantial novelty in a new combination of old devices should be pointed out. We cannot do this.

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11. For an improvement in the construction of *Railroad Cars;* William A. Davis, city of Baltimore, October 5.

Claim.—"The invention claimed consists in the arrangement of the main springs under the trucks, in the centre of the car, and suspending the same by links from said trucks, upon which springs the whole load, body and gear, are sustained by bolts projecting from the gear, passing through the trucks, and resting upon the convex surfaces of said springs. Also in arranging the side springs on the tops of the trucks for sustaining the car body in an upright position, in combination with the main spring, or springs."

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12. For a combined *Rocking and Castor Chair;* John David Brown, city of New York, October 5.

When this chair is to be used upon rockers, the back legs are removed; and when these are replaced the chair stands upon castors, it being thrown forward so as to rest upon those on the front legs, just in advance of the rockers. The claim is to this arrangement.

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13. For a machine for *Washing and Dressing Feathers;* Jonathan W. Howlet, Greensborough, Guilford county, North Carolina, October 5.

The operation of this machine is similar to that of several other feather dressers in which the feathers are to be agitated in a cylinder, under the influence of moisture and of heat, and does not contain any thing worthy of special notice.

14. For a machine for making *Butt Hinges;* Charles R. Macy, Hyde Park, Dutchess county, New York, October 5.

The hinges to be made by this machine are formed of strips of metal, which are to be first cut into halves, by means of a cutting press, so as to leave the projecting pieces ready to form the knuckle, the two halves corresponding in this particular. These pieces are to be bent upon a pin, or joint former, by means of the machine, which we shall not attempt to describe, for although not unnecessarily complex, its construction cannot be well made known without reference to the drawing. The claim is to the particular arrangements of the parts as described.

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15. For an improvement in the *Croze for Coopering;* James F. Broadhead, Kingston, Ulster county, New York, October 8.

"The object of my invention is to construct an instrument resembling, in many particulars, common circular bent planes, which shall cut the channeling in barrels, or any cask of a similar nature; and the result is that an instrument such as will be hereafter described, will perform this in a most perfect manner, without the operator being compelled to have recourse to more than one tool, as has been necessary in the employment of those heretofore known and used, and may be denominated the combined stock-trowel and croze."

The claim is to the particular form of the face and cutter, as represented in the drawings, so as to complete the channel in casks of all descriptions at one operation.

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16. For a machine for *Hulling and Cleaning Grain;* Jeduthan Cross, Lisle, Broom county, New York, October 8.

This machine consists of a hollow metallic cylinder placed horizontally, and having revolving beaters within it, which act upon the grain as it passes from the upper side at one end, to the lower side at the opposite end, where it escapes and is operated upon by a fan. The numerous machines for the purpose of cleaning grain, usually denominated smut machines, differ from each other principally in the form given to the beaters, and to the projecting points, by which the grain is to be acted upon, and to them the claims refer; in the present instance the patentee claims "the structure of the inside of the cylinder, composed of longitudinal and notched projections, intersected obliquely by smooth projections; the grooves running spirally around the front end of the said interior; and the relative positions of the hopper, the fan, and the flue." We have no doubt whatever that in the different patented machines, several may be found which are equally good in their operation, and that some have been patented which, could strict justice have been meted, would not have passed the office, but the question of similarity of means, where there is considerable difference in form, is one replete with embarrassment, and where doubts are entertained the claimants must be allowed to settle the question of their rights in a court of law, the office granting the patent to enable them to do this.

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17. For a machine for *Planting Seeds;* William Buckminster, Framingham, Middlesex county, Massachusetts, October 8.

This machine is intended to plant two rows of seed at the same time, and for this purpose it has two hoppers, one on each side piece of the frame. This frame constitutes a harrow, with two rows of teeth, one row on each

of the side pieces, the hoppers being placed immediately over the hind tooth. The claims are to "the loose joints in the planting harrow, and the setting of the teeth so as to follow directly after each other, as described; the mode of drawing the seed out of the hopper by means of an oblong rectangular cup; the gauge to regulate the quantity of seed; the mode of rising or sinking the sill on the wheel, so as to raise or sink the hind tooth, and thereby bury the seed deeper or more shallow in the earth, all as described."

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18. For an improved *Self Sharpening Plough;* John W. Post, city of Baltimore, October 8.

The claim is to "the peculiar manner of combining the share with the mould board and land-side, and the manner of regulating the position of the share by means of the slot or slots, in the share, as represented."

The difference between this self-sharpening plough and some which have been before patented, is very small, consisting, as will be seen by the claim, in the manner of fastening the share.

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19. For *Preventing Dust from Thrashing Machines;* Joseph Ross, Boundbrook, Somerset county, New Jersey, October 8.

Oblong pieces of wood, or other material, the length of the cylinder of a thrashing machine, are to have pieces of leather, or other suitable substance, projecting from one of their edges, forming a kind of comb, and these pieces are to be placed on the bonnet of the machine, so that the comb may pass between the teeth of the cylinder, and prevent the rising of dust from the grain. The claim is to "the attaching of one or more combs, or racks, such as is herein described, to the inside of the bonnet, or outer covering of a thrashing machine, on that side of the cylinder opposite the concave, or that part of the machine which contains the grain during the operation of thrashing, for the purpose set forth."

A device of this kind may be adapted to some cylinder thrashing machines, but it cannot be of universal application to the numerous kinds which have been patented. Its operation also must be imperfect.

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20. For a machine for *Shelling Corn;* Lester E. Dennison, Saybrook, Middlesex county, Connecticut, October 8.

The corn is to be shelled by means of a revolving cylinder, set with teeth spirally, the corn being borne up against the cylinder by an apparatus furnished with a spring. The affair is not very clearly described, and does not appear to have any particular claim to the time and space necessary to the making its peculiarities known.

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21. For an *Annular Saw* for sawing timber; Robert Grant, city of Baltimore, October 8.

This circular saw is to consist of a flat ring with the teeth upon its periphery. It is in fact like the common circular saw with its middle portion removed so as to leave a rim of two, three, or more inches in width. The saw is to be placed in a suitable frame furnished with friction rollers, which bear against its inner edge, and support it. In order to drive it, conical friction rollers are made to bear against its sides, opposite to each other, and these are to be driven by a band, or gearing.

Claim. "What I claim as my invention is the annular saw for cutting

timber, and the arrangement of the adjustable friction rollers, and beveled wheels, in combination with, and for the purpose of driving, the saw, as set forth."

We believe that this saw is new in its construction, and it is well calculated to remove the difficulty of *buckling*, from elevation of temperature in the cutting edge. It appears likely, however, that its defect will be a want of stiffness, and that it will be liable, therefore, to chatter when in use.

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22. For an improvement in the *Grist Mill;* Oliver Stevens, and Ezra Goodell, Port Lawrence, Lucas county, Ohio, October 10.

This patent is for a portable grist mill, the peculiarities of which are sufficiently made known by the claims, which are as follows:

"What we claim as our invention is the manner of securing the upper stone in an independent frame, by the use of the diagonal bolts, applied as set forth, by which the frame can be screwed up, and the stone firmly embraced, whenever it may be necessary. We also claim the hanging of the independent frame of the upper stone with hinges, allowing it to be turned back at pleasure, when the bolts are removed by which it is secured to the lower frame. We claim likewise the arrangement for hanging the lower stone, and regulating it by means of the square iron box, the square headed spindle, and the regulating screw, in their combined capacity."

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23. For a machine for *Ditching and Embanking;* Linton Thorn, city of Washington, October 10.

Various machines have been devised for the purpose of ditching and embanking, with a view, principally, to their employment in the extensive prairies of our country, where this procedure is the only one which can be followed in the formation of fences; the ordinary mode of digging and throwing up the earth by hand, is one of great labor and expense. A machine for this purpose, invented by Mr. George Page, was some time since essayed in the city of Washington, on very hard ground, and promised well, but such difficulties as usually attend new machines, have interfered with its introduction, and what are its present prospects we are not informed. The machine named at the head of this article has also been tried, but from a want of due strength, and some defects in the arrangement of the parts, it awaits improvements, and further trial.

The subjoined claim will afford a general idea of the construction of the cutting part of this machine. The cutters are made to revolve by horse power, and the earth cut is raised by means of an endless apron of sheet iron, and thrown on one side of the ditch to form an embankment, as the machine proceeds.

Claim. "What I claim as my invention and desire to secure by letters patent, is the construction, and manner of operating, the within described apparatus for ditching or excavating the ground; that is to say, I claim the arrangement of the cutters, as described, attached to and carried by a vertical, or nearly vertical, shaft, and forming in their revolution the frustum of an inverted cone, the sides being sloped in any degree which may be desired. I claim likewise the advancing of an excavating machine, as it cuts the ground, by means of an endless screw operating either regularly, or by an intermitting motion produced by the irregularity of the thread of the screw, as herein set forth. I also claim the giving of an intermitting motion to

such a machine by means of a toothed wheel, or by a ratchet wheel, combined and operating substantially as set forth."

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24. For an improved *Trunk Lock;* Joseph Nock, city of Philadelphia, October 10.

We cannot attempt to give the particular arrangement of the bolt, the tumblers, and the other parts of locks of this description. The permutations which these may be made to undergo, are too numerous for them to be written down, and were we to attempt it, it is not improbable that our description would be, at least, as inscrutable as the lock itself; this, however, we think a good one, being strong, and certainly difficult to pick. It does not differ essentially from some other locks made by the same manufacturer, excepting in the formation of the bolt by which it is adapted to trunks.

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25. For an improved *Silk Spinner;* Harrison Holland, Northampton, Hampshire county, Massachusetts, October 10.

The claim made is to a "method of stopping the machine when a thread breaks, by means of the drop rods, which throws the drums and whirls out of gear, in the manner described; and also the means of changing the twist by means of the short cylinders, in the manner described."

In the explanation of this machine there are upwards of fifty references to the drawing, yet it does not appear to be unnecessarily complex. Small perpendicular rods are suspended to each of the threads by bent wires, and should a thread break the rod which was suspended by it drops, and the extreme end of a lever to which it was attached is raised, comes in contact with a pin, or cog, on the periphery of the drum, and operates in such a way as to throw it out of gear and stop the machine.

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26. For an improved *Horse Power;* Jerub A. Fay, Baltimore, Maryland, October 10.

The horse is to walk upon a wheel either placed horizontally, or somewhat inclined. Under that part of the wheel upon which the horse stands there is a drum, or roller, which sustains the weight, and is, by the bearing of the wheel thereon, to drive the machinery to which the power is to be applied. Two other friction wheels are to be placed so as to prevent the tilting of the main wheel, whilst they do not prevent the weight of the animal from being sustained, mainly, by the drum. The claim is to "the manner of balancing the wheel upon which the horse is to walk, on its centre, without a vertical shaft, in combination with the mode of bracing the same, and of sustaining the part upon which the animal is to walk."

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27. For a *Planing Machine;* Joseph Lombard, Boston, Massachusetts, October 13.

The cutters of this planing machine are affixed upon the surface of a revolving horizontal table, those near its periphery operating as jack plane irons, and others within them as fore plane, and smoothing, irons. The stuff is to be fed in above the table, between feeding rollers, and a revolving brush is to clean the face of it as it passes in. The claims are "1st, The combination of the parts together, substantially as described, forming a machine for planing and reducing boards. 2d. The revolving brush for the object and purpose hereinbefore set forth."

The claim is rather more indefinite than is usually admitted, as it does

not point out any special arrangement, or combination of the respective parts, and we apprehend that its effect would be to confine the patentee to the precise arrangement as set forth.

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28. For improvements in the *Hardening or Chilling, the inner surface, &c., of Hubs of Railroad Car, and other, wheels;* Hopkin Thomas, Beaver Meadow, Northampton county, Pennsylvania, October 13.

"The nature of my invention consists in placing a conical pin of wrought or cast iron in the centre of the aperture left in the sand, where the core, or composition of sand, is usually placed to form a hollow cylinder; also a plate, or washer, at the upper and lower end of the hub, or cylinder, which harden the metal coming in contact with them."

"What I claim as my invention in the above specification is the construction and application of a chilling surface on the inside and ends of the hubs or naves of cast iron railroad car wheels, wagon boxes, or other cylindrical bearings; made by means of the combined chills, as described; also the construction and application of a groove made as described, within such chilled hub, or nave, wagon box, or other cylindrical bearing, for the reception of any lubricating substance."

When said wheels are cast, the chill pin is to be knocked out as soon as the metal has set, and water is to be poured into the cavity at intervals, so as to cool the hub as rapidly as other parts of the wheel, and thereby to prevent that tension which results from unequal cooling.

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29. For an improved mode of constructing *Stoves*; James Miller, city of Baltimore, October 16.

This stove is intended for heating apartments, and is furnished with tubes, valves, and dampers, designed to govern and direct the supply of heated air from the stove to distant apartments. The claim refers to the special arrangements devised by the patentee; and as there does not appear to be any thing new in these devices taken individually, the claim is confined to the special arrangement of the parts. These we do not think it necessary to attempt to set forth, as we are very apprehensive that the invention is not likely to be sought after.

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30. For *Stoves for Warming, and for Cooking;* Josiah Hill, Andover, Essex county, Massachusetts, October 16.

In this stove many devices are combined which are confessedly to be found in other stoves, and the claims refer, by letters, to these special combinations. The whole appears to be arranged with skill, particularly in its adaptation to cooking; the only objection to it which suggests itself is its being rather complex, although it is not more so than numerous other cooking stoves.

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31. For a *Portable Furnace*; Jordan L. Mott, city of New York, October 19.

(See Specification.)

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32. For a self tightening *Bush for Mill Spindles*; Henry Flinchbaugh, Lampeter, Lancaster county, Pennsylvania, October 19.

In this apparatus the mill bush has within it a divided follower, the outer

portion of which is conical, so that it shall be made to embrace the spindle as it is forced into the bush. A forked lever, with a weight attached to it, is made to enter the bush, and the continuous action of the weight keeps the followers, or nuts, to their bearing on the spindle. For keeping the spindle oiled, a small tube passes down through the husk, and under the bed stone, comes up through the bush, an opening being left for that purpose, and is thus conveyed to the followers and spindle. The claim is to the foregoing combination.

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33. For an improvement in *Thrashing Machines;* Frederick and Henry Greib, Hagerstown, Maryland, October 19.

The improvement claimed is in the manner of forming and inserting the spikes in the cylinder and concave. The spikes are to be flattened on their projecting ends, and they are to be fastened by screwing them into the cylinders. They are represented as made of round iron, champhered on two sides towards their points, and the claim is to the particular mode of adjusting the spaces between the spikes, in the concave, and on the cylinders; the adjustment being effected by the peculiar form of the spikes, and the manner of turning them.

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34. For a *Stove for Heating Apartments;* William Beach, city of Philadelphia, October 19.

The upper part of this stove has a flattened flue, in an arborescent form, presenting a wide radiating surface. The claim is to "the giving to the flues of stoves the flattened arborescent form and figure, in the manner, and for the purpose, set forth." The validity of such a claim, admits of doubt, as a mere change of form does not present a subject for a patent; but as the change, in the present case, increased the radiating surface, for the purpose of more effectually diffusing the heat, we presume it was considered as a tenable foundation for a claim.

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35. For *Temples for Looms;* Emory A. Angel, Killingly, Windham county, Connecticut, October 19.

This temple resembles, to a considerable extent, others previously in use, but the jaws are connected together in a different manner. The claim is to "the manner in which the upper and lower jaws are combined; that is to say, by pins forming the hinge joints of the jaws; the whole being constructed substantially in the manner set forth." This temple is of the kind which holds the selvedge of the cloth between jaws, which are opened by the beat of the lathe; in their general construction and action, such jaws are well known to machinists.

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36. For apparatus for *Jointing, Tongueing, and Grooving Boards;* Walter M. Hutton, Troy, New York, October 26.

This patent is taken for the particular manner in which the head is formed to hold the knives or cutters of a revolving tongueing and grooving wheel. The description is very elaborate, as the patent is dependent upon minute peculiarities of form and arrangement, the general construction not differing from that of other revolving cutters.

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37. For a machine for *Cutting, and Removing, Obstructions under Water;* Smith Cram, city of New York, October 26.

A wheel having cutters on its periphery is to be made to revolve under water, said wheel being hung on the end of a long shaft, or boom, projecting out from the deck of a vessel, and made capable of being raised or lowered by suitable tackles. A revolving shaft passes along the boom, and is bevel geared into the shaft of the cutter wheel. A universal joint connects the two segments of the revolving shaft, to allow the boom, with its cutter wheel, to be raised or lowered. These are the main features of this apparatus, which, it appears, is intended to cut off logs, or similar articles, under water. The claim is to the above described combination, the main parts of which are recapitulated therein. We do not think that this machine can be made to answer the intended purpose, as, in the stillest water, the motion of a vessel must not only interfere with, but, we apprehend, entirely prevent its operation.

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38. For constructing *Bedsteads;* Samuel P. Smith, Salina, Onondaga county, New York, October 26.

Instead of a mortise in the posts, a round, or other formed hole, is to be made in them, to receive the ends of the rails. These ends are to be tapered off, and the holes, also, made slopeing, that they may be adapted to each other; the posts and rails are then to be connected together by screws, in the ordinary manner.

Claim. "What I claim, is the manner in which I have combined and connected the above described tenon and mortise, whether in a round, four-sided, or other form, for the purpose of forming a tight and strong joint, which shall not become open or loose by use; that is to say, I claim the application of the principle by which tenons and mortises, larger at one extremity than the other, of a regular tapering form, are combined and connected in the construction of Bedsteads, in the manner above set forth."

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39. For a *Machine for making Safety Fuse,* for communicating fire in blasting rocks; William Lewis, city of New York, Oct. 26.

The description of this machine occupies six large folio pages; and a claim is made to "The combination of the reel frame and reels with the hollow shaft, cone and case, for making the inner case of the fuse, and in combination with them the grooved rollers for compressing the inner case. Also, the combination of the reel frame and the reels and hollow shaft with the cone and case, for the purpose of making and putting on the outer case of the safety fuse; and, in combination with them, the grooved rollers for drawing off and determining the length of the fuse; the whole being constructed and operating in the manner substantially as herein described."

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40. For a *Press for Cotton,* &c.; Alexander Jones, New Orleans, Louisiana, October 26.

The follower of this press is to be forced down in the first instance by means of racks and pinions, and, subsequently, when an increased power is required, by means of a screw. Two racks rise vertically from the follower, and into these gear two pinions on the same shaft, by the turning of which the follower is to be forced down. A vertical shaft having a screw cut upon its middle part, passes through the middle of the follower, and of the bed, and works in suitable boxes in the frame of the press, or the timbers of the building. On the upper side of the follower there is a divi-

ded screw nut, which, when the screw is not in action, does not touch the shaft; but when the follower has been forced down by means of the racks and pinions, the nut is, by means of levers, thrown into gear with the screw, and by turning the shaft in the ordinary way, the screw is brought into action. Two bales are to be pressed at the same time, one on each side of the screw shaft, which would otherwise be subjected to a great lateral strain.

The claim is to "the method of combining and working the screw, with the racks and pinions, wheel and shaft, in the same press, by means of two pieces of female screw nuts, constructed on the plan, and working substantially in the manner, and upon the principle, herein set forth, by means of which the expedition of the operation is greatly increased."

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41. For a Machine for *Excavating and Embanking;* Geo. Page, city of Baltimore, October 26.

This machine was referred to in No. 23 of this list, as having been some time since essayed in the city of Washington. It consists of a vertical wheel, or drum, carrying cutters which are to cut the two sides and the bottom of the ditch, as the wheel revolves. The wheel is turned by means of a shaft and bevil gear, actuated by the power of a horse. The earth is raised in vibrating buckets, or receivers, which, when they arrive at the top of the wheel, deposit it on a lateral chute, down which it descends, to form the embankment. The claims are to the manner of constructing the vibrating receivers; the mode of causing the machine to advance by coiling a rope round a drum, and the manner of regulating the same; the attaching a circular platform, or horse walk, to advance with the machine; the manner of adjusting the cutting wheel, or excavator; the application of teeth to the side cutters; the supporting the inner end of the chute or the axle of the excavator; the mode of changing the width of the ditch, and the slope of the sides, by setting the cutters, in the manner described.

Specifications of American Patents.

Specification of a patent for an improvement in the art of increasing the strength of Wrought Iron and Steel. Granted to Walter R. Johnson, *of the city of Philadelphia, July 9th,* 1838.

To all to whom these presents shall come: Be it known that I, Walter R. Johnson, of the city of Philadelphia, in the State of Pennsylvania, have invented a new and useful improvement in the art of increasing the strength of wrought iron and steel, and of articles formed of said materials, and that the following is a full and exact description of the machinery for carrying into effect the said improvement.

I construct a double trough or box of metal, or other convenient material capable of sustaining the action of fire, which trough I place over a flue or hot-air conductor supplied with hot air, gas, or smoke from stoves, fire-places or furnaces, situated at a convenient distance below it. Between the two parts of the said double trough or box, there is, included through the whole length of the same, a space, or cavity for containing and conducting the hot air, gas or vapour which I admit into it through holes or valves in the outer shell or box, over the hot-air flue already

described. This cavity I call the *heating-box*. The form of the cross section of the heating box will depend on that of the two troughs which compose it, and will be either rectangular, elliptical, or formed of two arcs of circles greater than semicircles, or in any other form which may be most convenient for the kind of work to be done. The proportions of the length, breadth and height of the box must in like manner depend on the form and the quantity of the materials which it may be found necessary to place within it, at any one time. The two troughs constituting the heating-box, may be united by riveting, or formed together by casting. There is an opening on the top of the inner trough through its whole length, by which the materials to be operated upon are introduced; but a cover or covers of iron or other materials may be adapted to fit it in such a manner as to prevent the escape of heat from within. Said covers may be formed either of simple sheets, shaped in the proper manner, or they may be metallic boxes filled with charcoal-dust, or other non-conductors of heat.

The aforesaid box or trough is to be set in brick work, or other substantial fire-proof materials; and surrounded by non-conducting substances, except the top, ends, and such other parts as may be exposed for the purpose of bringing out the pyrometric rods hereinafter described. In the bottom of the outer shell or trough, or at the ends in the space between the two, are a number of holes for admitting hot air, gas, vapour, flame or smoke into the heating box; and from the top of said box, either at the ends, or at any convenient intermediate points, are flues or tubes for carrying off the hot air or gas, after it has traversed the heating box. In order to measure the temperature of the inner trough and of its contents, I employ any form of thermometer or pyrometer, or the expansion or fusion of any solid substances, or the evaporation of any liquid which may be found best adapted to each particular form and size of the apparatus. Bars of metal, either simple or compound, and traversing the heating box, either longitudinally, transversely, or in spirals, may by their expansion, be made to act on a lever or levers, wheel or wheels, and give motion to indexes moving over graduated straight or curved lines. For heating apparatus on a large scale, I employ the following construction of apparatus to serve as a pyrometer. On the inside of the inner trough, near the bottom, are two projections of metal, at a convenient distance apart, between which are to be placed the two ends of a bar of brass so long as to require to be bent or curved slightly, in order to be made to enter between the said projections, in one of which is a screw to regulate the curvature of the bar, by increasing or diminishing the pressure on its two ends. From the middle of the said bar of brass, there proceeds a rod passing out through the side of the double trough by holes perforated for that purpose, and the said rod gives motion to levers, or wheel work for moving indexes as before stated. Instead of connecting the brass bar to the side of the heating box, I shall sometimes attach it, in a manner similar to that above described, to a stiff bar or rod of cast iron, plumbago, glass or other substance of a low rate of expansion by heat; and shall, when necessary, use two bars of brass, on opposite sides of the same bar of the other material, so that they may form a bow each way from the central line or bar. In the latter case, the instrument will bear a near resemblance to Regnier's pyrometer, and the rod will pass from one brass bar to the other, to move the index situated on the latter, traversing in its course the intermediate bar of the material of low expansion. When the expansion of solids is employed for indicating the temperature of the heating apparatus, I make use of the same to close

the holes in the outer box already mentioned, and to open a register from the flue beneath the heating box into an escape pipe connected with the same, thereby allowing the heated air to pass off without coming in contact with the inner trough. When I mark and regulate the temperature of my heating apparatus by the expansion of bars, and the motion of indexes and valves as already described, I graduate the scales over which said indexes are to pass, by ascertaining the points at which they stand at two or more given temperatures, in the following manner. After establishing the heating box and pyrometer firmly in their place, I surround the pyrometer with snow or pounded ice, which is allowed to remain until the whole apparatus has acquired a temperature of 32° Fah., which is marked at the point where the index then stands. Heat is then applied by lighting fires in the stoves or furnaces, the ice is melted and made to boil briskly, surrounding the pyrometer with boiling water or steam, and when the index becomes stationary, I mark the point 212°. The water is next removed, and around the pyrometer bars are wrapped leaves, strips or masses of pure tin, after which the heat is very carefully raised until they shall be perceived to be melting and falling off; the point at which the index then stands is marked 442°. A number of thin glass flasks of mercury are then disposed along, contiguous to the pyrometer bars, and when they begin to boil, the scale is marked 652° at the point denoted by the index. When I would mark higher temperatures than that of boiling mercury, I ascertain them by placing on or near the pyrometer bar, an iron vessel to hold melted tin, into which is plunged the standard piece of a steam pyrometer. The apparatus is then heated to any required extent, and, noting the position of the index, I withdraw the standard piece, and immediately plunge it into the boiling water of the pyrometer to which it belongs to ascertain in the usual manner the number of degrees which must be set upon the point which was given by the index, on taking the standard piece out of the tin. Another mode in which I regulate the temperature of the heating box, is, by making it air tight, but instead of using it as a passage for hot air, placing within it a quantity of mercury or other liquid having a high boiling point sufficient to occupy all that part of the lower, or outer, trough, which is exposed to the flue below it. The inner trough and the pieces of metal under process, will then be heated by the vapour of the liquid surrounding them. In this case, instead of flues in the upper part of the box to carry off the air, as above described, are placed funnel-shaped receptacles for the vapour of mercury, or other liquid, in which it may be condensed and flow back again into the heating box. A safety valve of the common form will be placed in this receptacle to secure the box from injury by explosion. When I apply the heating box to the purpose of heating pieces of great length, instead of establishing it on fixed and solid masonry, I place it on a car, together with its furnace and apparatus, and the said car together with its furnace and appendages, is then set on rails beneath the piece of metal to be acted on, and caused to move at a convenient speed, from one end to the other of the iron, communicating in succession the same temperature to every part of the piece. This method is particularly applicable to the wire cables used for sustaining suspension bridges.

To know when each part of the metal has arrived at the proper temperature, sheets of metal or of some alloy which melts at a temperature below 600° Fahrenheit, are disposed at short intervals along its whole length, and the velocity of the car is regulated by the readiness with which they are melted off. Instead of the kind of heating apparatus and machinery herein

employed for increasing the strength of iron by the process of thermotension, I shall, when iron is manufactured by rolling, whether into bars or sheets, perform that process by drawing it for the last time, forcibly through the rolls, while the temperature is not above 600° Fahrenheit. In like manner, in manufacturing wire, I place a heating apparatus in such a position that the wire after passing the draw plate, shall be heated to 550° Fah. before it is wound up by the spool, or reel.

Another improvement which I have made on the art, or process of increasing the strength of iron and steel by the process of hot straining is, that instead of the usual forms of dynamometer, or apparatus to measure the force applied to the metal, I make use of a straight beam or lever, one end of which is loaded with any convenient constant weight, and near the other end is a gudgeon to take hold of two straps which are placed on each side of the beam. These straps are extended to any convenient distance beyond the beam and terminate in, or are connected with, the hook, or other holding apparatus for connecting the pieces of iron to the dynamometer. Between the said gudgeon and the weight at the opposite end of the lever, is placed the fulcrum, which is to be applied to the solid support of the dynamometer, but instead of consisting of a simple gudgeon, I form this fulcrum of a solid casting, or other strong piece of metal, bent twice at right angles, and having the lever traversing its middle section between the two projecting arms of the bent portion, each of which being then reduced to a proper bearing edge, they constitute together the *principal fulcrum.* The opening between the two parts of this fulcrum is intended to give room for the straps already described, and to allow the *fulcrum distance* to be diminished at pleasure. The weighted end of the beam plays between two quadrantal arcs of a circle, each of which is cut into a ratchet, and has on the side of the lever a click to correspond, which will support the lever at any elevation less than the whole length of the arc.

In using this dynamometer, the *ratchet-arc* serves as a register for the strength of the metal, being made to hold the lever at the elevation to which it would be raised by such a strain as would break the piece under trial at ordinary temperatures. Any addition to the force, will raise the loaded end of the beam. The graduated ratchet arc, is marked with the number of tons or other weights which the dynamometer measures, on the principle that the force applied on the shorter arm of the beam in a horizontal direction, will, if the beam be supposed to be, when unloaded, self balanced on its principal fulcrum, be directly proportional to the weight placed on the longer arm, multiplied by the length of that arm, and again multiplied by the sine of the angle measured on the arc, reckoning from the lowest point of it, and inversely proportional to the length of the shorter arm multiplied by the co-sine of the same angle measured in the manner just stated. The above described heating box is, when used, to be placed so that the mechanical power which strains the metal shall be at, or opposite to, the end of the box, and the dynamometer, above described, at the other, with proper holding machinery to connect each with the pieces of metal, which are to undergo thermotension.

What I claim as new in this invention is the above described double trough forming a heating box, with its apparatus, valves, registers, flues, receptacles for condensed vapour, and its other appendages, as the same are applicable to the purpose of increasing the strength of iron and steel, in the process of straining the same at a high temperature. I also claim the method of increasing the strength of bars, rods or plates of iron, by

drawing them, while hot, through the rolls, by mechanical power, of any suitable kind. I also claim the increasing of the strength of wire, by heating the same after passing through the draw plate, as described above.

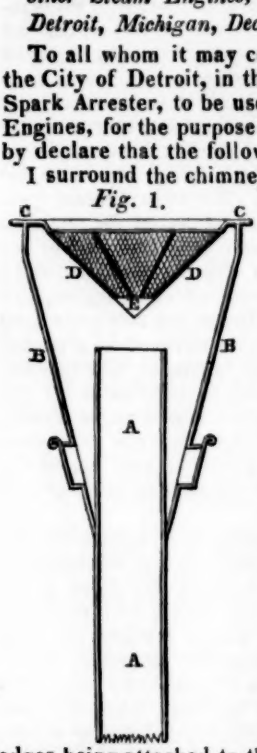
WALTER R. JOHNSON.

Specification of a Patent for a Spark Arrester, to be used on Locomotive and other Steam Engines; granted to Benjamin Briscoe, Engineer, City of Detroit, Michigan, December 15th, 1838.

To all whom it may concern: Be it known that I, Benjamin Briscoe, of the City of Detroit, in the State of Michigan, have invented an improved Spark Arrester, to be used on the chimneys of Locomotive and other Steam Engines, for the purpose of preventing the escape of sparks; and I do hereby declare that the following is a full and exact description thereof.

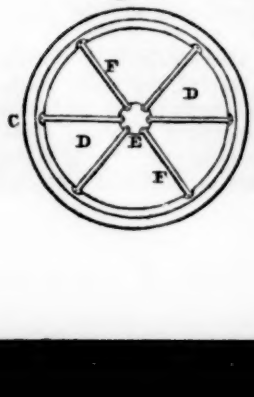
I surround the chimney of the engine by an inverted cone of sheet iron, the lower end of which embraces, and is attached to the chimney, at the distance of three feet, more or less, from the top of said chimney, its upper edge rising above the top of the chimney to the height of from twenty inches to two feet, where its diameter may be three times that of the chimney. To strengthen the upper edge of this inverted cone, and to sustain an inverted cone of wire gauze, I affix thereto an iron ring, which is so constructed as to answer another useful purpose, to be presently described. In the accompanying drawing, Fig. 1, is a vertical section of the chimney, and its appendages; and Fig. 2, a top view of the ring, with the ribs which are to support the wire gauze. A, A, is the chimney, B, B, the inverted cone of sheet iron surrounding it, the space between it and the chimney serving as a receptacle for the sparks and ashes; there being sliding or other doors, *a*, *a*, provided for removing them when necessary. C, C, is the iron ring which surrounds, and is attached to, the upper edge of the cone, B, B. This ring I usually make about three inches wide, its outer edges being attached to the cone, in consequence of which it projects inwards, lessening the diameter of the opening about six inches. Its lower flat side thus presents a space against which the sparks strike, which are conducted up to it by the inverted cone of wire gauze, where, not being subjected to any draught, they fall readily into the receptacle.

Fig. 1.



D, D, is the inverted cone of wire gauze, which is attached at its upper edge to the hoop C, C, and at its lower edge to a disk or piece of sheet iron E. This lower end may be about ten inches above the top of the chimney. F, F, Fig. 2, are ribs of iron to which to attach the wire gauze. The part which I have denominated the inverted cone of wire gauze may be a segment of a sphere, as well as of a cone, and may be made to produce the same mechanical effect.

Fig. 2.



The sparks as they rise from the chimney strike

against the wire gauze, and from its position they are carried by the draught up its inclined sides until they come into contact with the under side of the ring, whence they fall, as already stated. The inner edge of the ring may be made to incline downwards, in the direction of the wire gauze. The difference between the action of the draught upon a flat, or a concave surface, in detaining the sparks, and the action upon such a one as I have described will be apparent; as its tendency in the former case is to cause them to adhere to, and in the latter to slide upon the surface, thus perpetually freeing it from their obstructing influence.

What I claim as my invention, and desire to secure by letters patent, is the employment, for the purpose of arresting sparks, of an inverted cone, or curved segment, of wire gause, combined and connected with the surrounding ring, and the other parts of the apparatus, substantially in the manner herein described.

BENJAMIN BRISCOE.

Specification of a patent for constructing Portable Furnaces; granted to JORDAN L. MOTT, *of the city of New York, October 19th,* 1838.

To all whom it may concern; Be it known, that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented certain improvements in the manner of constructing Portable Furnaces, and I do hereby declare that the following is a full and exact description thereof.

Fig. 1.

Fig. 2.

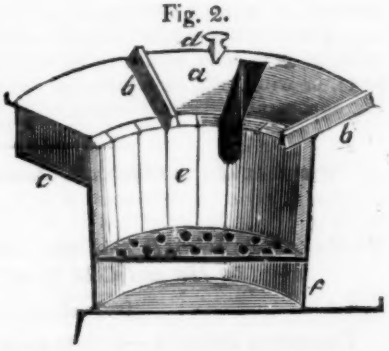


Fig. 3.

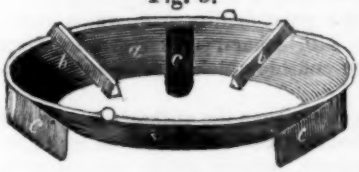


Fig. 1, in the accompanying drawings, represents the furnace in perspective. Fig. 2, is a vertical section through the middle of it; and Fig 3 shows the rim or flaring part, with its appendages separated from the cylindrical, or body part, of the furnace, for the purpose of employing it in a manner to be presently described. These furnaces are usually made of cast iron, and they may be made either in one or two parts, the rim or flaring part, *a*, *a*, being in the latter case attached to the cylindrical or body part,

by screws or otherwise. Upon this rim I form three or more ridges or projections *b*, *b*, upon which the cooking utensils are to rest, the height of these ridges determining the flue or space between the rim *a*, and the bottom of the boiler, or other utensil placed thereon. I also construct three hollow, or deep recesses, *c*, *c*, into which the legs of iron pots may be received, so as to allow their bottoms to rest upon the ridges, *b*, *b*, or instead of this recess I cut openings or slots through the said rims, for the same purpose. The cylindrical part, *d*, *d*, I line as shown at *e*, *e*, with soap stone, fire-clay, or other nonconductor of heat. The ash pit, *f*, I usually make somewhat smaller in its diameter than the body, *d*, thus leaving an offset, upon which the lining may rest at its lower end, when the furnace is cast in one piece. I allow the inner ends of the ridges, *b*, *b*, to project within the edge of the rim, so as to cover, and in part to confine the lining in its place; when the rim is made separate from the body of the furnace, I allow the whole inner edge to project over so as to cover the top of the lining, and after completing the latter, attach the rim to the body, as before indicated. When the rim, with its appendages, is made separate from the body of the furnace, as shewn in fig. 3, I employ it to cover and surround any boiler hole in stoves, furnaces, ranges, or other cooking apparatus to which it may be adapted, so as to fit them to receive the various kinds of utensils in ordinary use, as pots, kettles, boilers, &c.

I do not claim the mere making of the upper part of a portable furnace flaring, this having been previously done, but not in the manner above set forth; what I do claim, therefore, is the making of a rim or flaring part, projecting out from the upper part of a cylindrical, or nearly cylindrical, body; and having upon it ridges, to support the utensils placed thereon, in the manner, and for the purposes set forth. I also claim, the providing of the recesses, or instead thereof, the making of slots, in such rim, to admit with equal facility the legs of pots of various sizes. I also claim the making and using of such rims, or flaring tops furnished with ridges, or with recesses, or slots, or with both, to be adapted and applied to the boiler openings in cooking apparatus of various kinds. JORDAN L. MOTT.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the relative Strength and other mechanical Properties of Cast Iron obtained by Hot and Cold Blast. By EATON HODGKINSON, Esq.

[CONTINUED FROM PAGE 196.]

Transverse strength.—It is to ascertain the resistance of materials to a transverse strain that the efforts of experimenters have chiefly been directed. One reason for this seems to be the great facility with which bodies can be broken this way comparatively with others, which require large weights or complex machinery, and often considerable attention to theoretical requirements.

In making the following experiments, it has been the author's aim, whilst he kept in view the inquiry respecting hot and cold blast iron, to make the results subservient to some other purposes, besides giving an extended view of the application of these irons.

As the inquiry was a comparative one, and required that a number of experiments, and those similar to each other, should be made upon each

iron from any particular place, several models were made, and castings, both of hot and cold blast iron, obtained from them; and as it seemed desirable to trust in these experiments as little as possible to theory, some bars, one inch square, were always obtained from the same model. From these, and from others, a satisfactory comparison of the relative strengths of the irons would have been obtained without the use of theory, could the castings have always been got of the exact size of the model; but as small deviations in this respect were unavoidable, theory was employed to effect the slight reduction in the results of each bar to what they would have been if the bars had been of the exact dimensions of the models.

All the bars used in these comparisons are uniform and of the same length, and the theoretical assumptions with regard to the strength and deflection are of the simplest and most generally admitted kind. They are as below; the strength in rectangular bars is taken as the breadth multiplied by the square of the depth, and the ultimate deflection is supposed to be inversely as the depth. To these there has been added another, namely, that the power of bearing an horizontal impact from a given weight is measured by the strength of the beam multiplied by its ultimate deflection. This last assumption supposes that all cast-iron bars of the same dimensions in our experiments are of the same weight, and that the deflection of a beam up to the breaking weight would be as the pressure. Neither of these is true, they are only approximations; but the difference in the weights of cast-iron bars of equal size is very little, and taking them as the same, it may be inferred from my paper on impact upon beams (Fifth Report of the British Association), that the assumption above gives results near enough for practice.

After the following tables, therefore, there will always be given a summary of the strengths and deflections, reduced to what they would have been supposing the bar to be of the exact size of the model; and attached to these there will be the other values mentioned above, representing the power of the beam to bear impact.

The modulus of elasticity is set down that it may serve as a measure of the comparative stiffness of the irons. It is given in pounds per square inch.

The ultimate deflection attached to each experiment was derived from the results last obtained, and as these results were usually more numerous than those set down, the deflection cannot often be calculated from those which remain, but is nearer to the truth than those which might be obtained from the remaining ones.

In all the subsequent experiments, the bars were cast 5 feet long, and were supported on props 4 feet 6 inches asunder, except it is otherwise mentioned, which will only be found in two cases.

In the prosecution of the experimental part of this research, it gives me great pleasure to acknowledge the efficient manner in which my views were carried into execution by Mr. John Patchett, an intelligent pupil of Mr. Fairbairn.

TABLE I.—Results of experiments to ascertain the transverse Strength of Carron Iron, No. 2. All the castings were uniform throughout; they were cast 5 feet long (except otherwise mentioned), and supported during the experiments on props 4 feet 6 inches asunder; the pressure being applied in the middle. The weight of the bars, when given, are those of the whole length.

Hot Blast Iron, made with Coke.

Experiment 1. Rectangular bar, 1.00 deep. 1.00 broad. Weight 15 lbs. 2 oz.			Experiment 2. Rectangular bar, 1.017 deep, 1.010 broad. Weight 15 lbs. 11 oz.			Experiment 3. Rectangular bar, .996 deep, 1.002 broad. Weight 15 lbs. 3 oz.			Ex. 4.—Bar 7 ft. long supported on props 6 ft. 6 in. asunder.—Its form of section broken as shown with the rib downwards. T			Ex. 5.—Bar from the same model as the last, supported on props 6 ft. 6 in. asunder, broken with the rib upwards, thus. ⊥			Ex. 6.—Bar 5 ft. long, broke on supports 4 ft. 6 in. asunder, same form as before, but smaller vertical rib broken with rib downwards. T			Ex. 7.—Bar same as the last, broke with rib upwards. ⊥		
Weight in lbs.	Deflection in inches.	Set, or deflection when unloaded.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
16	.037	visible increased				16	.038	visible	7	.015	visible	7	—	not vis.	112	.20		112	.20	
23	.052		23	.051	visible	23	.052	..	14	.032	.001?	14	.025	visible	168	.30	.01	224	.40	
30	.070	.001?	30	.067		30	.070	.001?	21	.046	.002	21	.045	.002	196	.36		280	.50	.02
56	.132	.002	56	.129	.001	56	.133	.004	28	.064	.004	28	.065	.003	224	.42	.02	336	.60	
112	.271	.008	112	.261	.006	112	.276	.009	56	.130	.005	56	.134	.005	252	.49		392	.72	.07
224	.588	.037	224	.561	.030	224	.598	.040	112	.273	.020	112	.270	.015	280	broke		448	.84	
336	.940	.087	336	.900	.077	336	.958	.094	168	.444	.035	224	.580	.058				560	1.12	.18
448	1.360	.181	448	1.297	.153	448	1.388	.187	224	.618	.058	336	.895	.101				672	1.47	
469	broke		476	broke		462	broke		280	.813	.093	448	1.224	.155				784	1.92	
									336	1.030	.130	560	1.585	.235				896	2.55	
									364	broke		672	1.985	.330				952	2.95	
												784	2.410	.490				980	broke	
												896	3.450	.722						
												1008	4.140	1.040						
												1064	—							
												1120	broke							
Ultimate deflection=1.444			Ultimate deflection =1.400.			Ultimate deflection =.446.			Ultimate deflection =1.138.			Fracture caused by a wedge 2.92 in. long and 1.05 deep flying out of the form ⌒ Ultimate deflection =4.630			Ultimate deflection =.55			Fracture caused by a wedge 4.9 ins. long flying out of the form ⌒ Ultimate deflection =2.15		

TABLE I, continued.

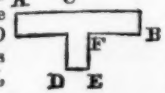
Ex. 8.—Bar an iron[illegible] Ex. 9.—Bar same as Ex. 10.—Bar same as Ex. 11.—Bar cast 14 Ex. 12.—Bar

TABLE I, continued.

Ex. 8.—Bar an isosceles triangle. Base 1.43 in. Each side 2.00. Broke with the vertex downwards ▽			Ex. 9.—Bar same as the last, filed to the exact size. Broke with vertex downwards as before. ▽			Ex. 10.—Bar same as the last, but one-tenth of the depth taken off the vertex. Broke with vertex downwards. ▽			Ex. 11.—Bar cast 1¼ inch square, and reduced in the middle to 1.019 deep, 1.021 broad.		Ex. 12.—Bar cast the same as last, and reduced in the middle to 1.013 deep, 1.017 broad.		Ex. 13.—Bar a rectangle, 3.00 inches deep and 1.03 " broad.			Ex. 14.—Bar a rectangle. 4.98 inches deep, 1.02 " broad. Length 5 feet, Weight 78 lbs.			Ex. 15.—Bar from the same model as the last. 4.97 inches deep, 1.02 " broad. Weight 77 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Set.	Weight in lbs.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	.07		112	.07		112	.075		112	.01	112	.005	1082	.085		5867	.127		4936	.105	
168	.11		168	.102		168	.11	.004	168	.025	168	.02	1343	.106	+	6798	.153	.01	5867	.133	.009
224	.15	.002	224	.140	.002	224	.15	.005	224	.04	224	.05	1474	—	.001	7730	.177		6798	.152	.01
336	.24	.01	336	.22	.01	336	.24	.01	336	.10	336	.15	1605	.130	.003	8661	.207		7730	.190	
448	.33	.02	448	.31	.015	448	.34	.017	392	.15	392	—	1866	.156	.006	9593	.235		8662	.223	
560	.44	.04	560	.40	.03	560	.44	.035	448	.21	448	broke	2126	.185	.010	10524	.275	.03	9034	it bore	
616	.50		672	.51	.05	672	.55	.06	504	broke			2388	.212	.012	11087	broke		9220	broke	
644	.53		784	.62	.08	700	.59						2649	.243	.017						
672	broke		812	broke		728	broke						2910	.272	.022						
													3172	.307	.03						
													3433	.340	.038						
													3694	.378	.05						
													3956	broke							
∴ Ultimate deflection=.56.			∴ Ultimate deflection=.65.			∴ Ultimate deflection=.63.							∴ Ultimate deflection=.416.			∴ Ultimate deflection=.299.			∴ Ultimate deflection=.244.		

Notes. Two samples have been obtained of both the Hot and Cold Blast Carron Irons, No. 2. The first five experiments in Table I, and the first three in Table II, were from samples obtained after all the other experiments on this iron had been made; they perhaps give results a little higher than those previously obtained.

In experiments 4, 5, 6, 7, the transverse section of the casting may be represented by A, C, B, F, E, D, where A B and F D are parallelograms, each part being of uniform thickness. In experiments 4 and 5 the area of the parallelogram A B=5×.30 inches, the thickness being .30. In the former of these experiments C D=1.45, and D E (which may represent the uniform thickness of the rib D F)=.36 inch. In the latter experiment C D=1.56, and D E=.365 inch. These two experiments were the only ones where the castings were more than 5 feet long. The castings in Experiment 6 and 7 give nearly as follows: Area A B=5×.27 inch, C D=1.27, D E=.25 inch.



Results of the Rectangular Bars above reduced to those of Bars 1 inch broad, and 1, 3, and 5 inches deep. Distance between supports 4 feet 6 inches.

	Specific gravity	Modulus of elasticity in lbs. per square inch.	Breaking weight in lbs. (b).	Ultimate deflection in in's. (d).	Product $b \times d$ or power of resisting impact.
Experiment 1st, bar one inch deep and one inch broad	7020	16269000	469	1.444	677.2
Do. 2nd, do. do.		15901000	456	1.424	649.3
Do. 3rd, do. do.	..	..	465	1.144	532.0
	Mean	16085000	463	1.337	619.5
Do. 11th, do. do.	7031	..	475		
Do. 12th, do. do.	7008	..	429		
	Mean	..	452		
Do. 13th, three inches do.	..	..	3843	.416	1598.7
Do. 14th, five inches do.	7070	..	10957	.298	3265.2
Do. 15th, do. do.	7100	..	9149	.243	2223.2
Mean	7046	..	10053	.270	2744.2
Results of Experiments not reduced.					
Experiment 6th, bar-rib extended	..	..	280	.55	154.0
Do. 7th, do. compressed	..	..	980	3.15	3087.0
Do. 8th, Triangle	..	..	672	.56	376.3
Do. 9th, do.	..	..	812	.65	527.8
Mean	..	..	742	.60	452.0
Do. 10th, Frustum of do.	..	..	728	.63	458.6

Table II.—Results of experiments on the Transverse Strength of Carron Iron, No. 2. Lengths of bars, and distance between the supports as before. Cold Blast Iron made with Coke.

Ex. 1.—Rectangular bar 1.025 deep, 1.002 broad. Weight, 15 lbs. 6 oz.			Ex. 2.—Rectangular bar 1.021 deep, 1.015 broad. Weight, 15 lbs. 11 oz.			Ex. 3.—Rectangular bar 1.040 deep, 1.026 broad. Weight, 16 lbs. 2 oz.			Ex. 4.—Uniform bar. Form of section. T Broke with the vertical rib downwards.			Ex. 5.—Bar from same model as the last. Broke with the vertical rib upwards. I			Ex. 6.—Bar from the same model as in experiment 6 Hot Blast. Broke with the rib downwards.			Ex. 7.—Bar from the same model. Broke with the rib upwards.		
Weight in lbs.	Deflection in inches.	Set, or deflection when unloaded.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
16	.033	visible	30	.061	visible	16	.034	doubtful	112	.03	..	112	.03	..	112	.19	..	112	.21	
30	.062	increased	37	.076	increased	23	.049	visible	224	.07	..	224	.07	..	126	.21	..	168	.30	.01
56	.12	.002	56	.115	.001?	56	.116	.005	336	.11	..	336	.11	..	140	.26	..	224	.40	.025
112	.24	.007	112	.223	.002	112	.228	.008	392	.13	.005	448	.15	..	154	.27	.01	280	.50	.03
168	.37	.014	168	.358	.011	168	.345	.011	420	.14	.007	560	.19	.005	168	.31	.015	336	.60	..
224	.51	.028	224	.49	.019	224	.470	.018	448	.15	.01	616	.21	.01	182	.32	..	392	.71	.06
280	.649	.041	280	.616	.032	280	.599	.030	560	.19	.012	672	.23	..	196	.37	..	448	.82	..
336	.798	.061	336	.757	.05	336	.732	.047	672	.23	.015	728	—	.015	210	.39	..	560	1.09	.15
392	.953	.084	392	.908	.073	392	.878	.069	784	.28	.023	784	.27		224	.43	.03	672	1.39	.26
448	1.12	.12	448	1.068	.101	448	1.030	.095	896	.33	.03	896	.31		238	.46	..	784	1.76	.44
504	1.31	.17	504	1.252	.147	476	broke		952	.35		1008	.35		252	.50	.045	896	2.30	
514	it bore		532	it bore					980	broke		1120	.39		266	broke		1008	2.95	
518	broke		539	broke								1344	.48					1036	3.15	
												1568	.57					1050	broke	
												1792	.67							
												2016	.80							
												2240	.95							
												2296	it bore							
												2352	broke							
Ultimate deflection = 1.36. Broke ¾ of an inch from the centre.			Ultimate deflection = 1.367.			Ultimate Deflection = 1.106			Ultimate deflection = .36.			Ultimate deflection = 1.03. Fracture by a wedge breaking out as in ex. 5 Hot Blast.			Ultimate deflection = .53.			Ultimate deflection = 3.23. Broke by the separation of a wedge as in ex. 7 Hot Blast.		

TABLE II, continued.

Ex. 8.—Bar, whose section was an isosceles triangle, filed to a gauge same as in experiment 8 and 9 Hot Blast. Broke with vertex downwards.			Ex. 9.—Bar same as the last except its having 1-10th taken off the vertex, as in experiment 10 Hot Blast. Broke with the vertex downwards.			Ex. 10.—Bar cast 1¼ inch square, and reduced in the middle to 1.020 deep 1.020 broad.			Ex. 11.—Bar cast the same as the last, and reduced in the middle to 1.014 deep 1.014 broad.			Ex. 12.—Bar a rectangle 3·00 deep, 1·02 broad. Weight 46 lbs. 8 oz.			Ex. 13.—Bar a rectangle 4·98 deep, 1.03 broad. Weight, 78 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	.07	...	112	.07	...	98	...	.003	98	...	.005	1082	.091	.003	4936	.110	.013
168	.105	.003	168	.11	...	112	...	.003	112	...	.005	1343	.111	.006	5867	.130	..
196	.120	.009	196	.125	...	140	...	.01	140	...	.01	1605	.138	.008	6798	.153	.02
224	.145	...	224	.15	...	168	...	.02	168	...	.02	1866	.164	.010	7730	.179	.025
280	.18	.01	238	—	.002	196	...	.03	196	...	.03	2126	.190	.012	8662	.195	..
336	.22	...	252	.165	.002	224	...	.04	224	...	.04	2388	.220	.015	9593	.219	.034
392	.26	...	280	.19	.002	336	...	.09	336	...	.13	2649	.250	.019	10525	.250	.042
448	.31	...	336	.23	.003	392	...	.13	392	...	.16	2910	.281	.026	10588	broke.	
504	.36	...	392	.27	...	448	...	.19	448	...	.25	3172	.310	.031			
560	.41	.04	448	.32	.01	476	broke.		476	broke.		3433	.345	.037			
616	.45		504	.36	...							3694	.378	.046			
672	.51		560	.42	.025							3825	broke.				
728	.56		616	.47													
784	.62		644	.50													
815	broke.		677	broke.													
∴ Ultimate deflection = .65.			∴ Ultimate deflection = .53.									∴ Ultimate deflection = .395.			∴ Ultimate deflection = .252.		

NOTE.—The dimensions of the bars in Experiments 6 and 7 were very nearly the same as those given in the note to the same experiments on the Hot Blast Iron. In these the thickness of the vertical rib was ¼ inch, and its depth 1 inch; the whole depth of the casting being 1.27. In Experiments 4 and 5 above, the area of a section of the casting was the same as in the others just mentioned, and the thickness of the parts nearly the same, but the vertical rib was of double the depth, or about 2 inches deep; the whole depth being about 2.27 or a little more. This rib, however, was slightly tapered towards the ends, and therefore the results from these experiments were not strictly comparable with those from the others.

Results of the Rectangular Bars above reduced to those of Bars 1 inch broad, and 1, 3, and 5 inches deep. Distance between supports 4 feet 6 inches.

	Specific gravity.	Modulus of elasticity.	Breaking weight in lbs. (b).	Ultimate deflection in inches (d).	Product $b \times d$ or power of resisting impact.
Experiment 1st bar one inch deep and one inch broad . .	7087	17025000	492	1·394	686
Do 2nd, do do	7082	17516000	509	1·396	711
Do 3rd, do do			429	1·150	493
		Mean	476	1·313	630
Do 10th, do do	7139 / 7017		449		
Do 11th, do do	7008		457		
	Mean 7066		453		
Do 12th, three inches do			3750	3·95	1481
Do 13th, five inches do			10362	2·51	2601
Results of Experiments not reduced.					
Experiment 6th, bar-rib extended			266	·53	141
Do 7th, do. do. compressed			1050	3·23	3391
Do 8th, Triangle			815	·65	530
Do 9th, Frustum of do.			677	·53	359

Note.—I have been favored by Mr. Fairbairn with the annexed examination of the structure of this and the following Irons:—

"The Carron No. 2, cold blast iron, when viewed with the microscope, presents a dull grey color, finely granulated, with an appearance of greater porosity in the centre than round the extreme edges of the fracture. It is a free working iron, easily cut with the turning tool, but indicates stiffness under the file.

"Carron No. 2, hot blast. This iron has nearly the same character in its working properties as the above; it files with rather more freedom, and possesses an appearance of greater fluidity than the cold blast. Color, a greyish blue, accompanied with a greater degree of uniformity in its crystaline structure than the cold blast.

"Buffery No. 1, cold blast, is finer grained than either of the Carron irons. It is chiefly composed of minute granules intermixed with small brown specks; it works with less freedom than the hot blast, and cuts with difficulty under the tool. In this respect it is much akin to the Milton iron (described in Mr. Fairbairn's paper.)

"Buffery No. 1, hot blast, has a similar appearance to the Carron, No. 2, cold blast; it has more lustre than Buffery No. 1, cold blast; the crystals are widely separated in the centre, but more compact as they approach the outer edge of the bar.

"This appearance is nearly peculiar to the whole of the hot blast irons."

Remarks upon the Experiments in the preceding Tables.—In devising the preceding experiments the writer had several objects in view, which he will now proceed to state. It has been remarked above that the first five experiments on the hot blast iron, and the first three on the cold blast, in the tables above, were made after the others. These will therefore be passed over for the present, and we shall commence with experiments 6 and 7, which, like most of the others, are on bars from the same model in both tables. The object of these experiments was to show the influence of form of section in beams of cast iron; and it will be seen from the results, that when the rib was downwards, the casting broke with 280 lbs. in the hot blast iron, and 266 lbs. in the cold blast. When the rib was upwards, the breaking weights were 980 lbs. and 1050 lbs. respectively; the bars bearing nearly four times as much one way up as the other. These results are contrary to the opinions of some leading writers, as Tredgold and others, who, from their principles, would maintain that the strength should be equal in the two cases. An experiment of this kind I gave in a paper on the strength and best forms of iron beams (Memoirs of the Literary and Philosophical Society of Manchester, vol. v.,) and it formed indeed the basis of the inquiry in that paper.

I had remarked in some of the experiments upon the Carron iron, and more particularly the Buffery following, that the elasticity of the bars was injured much earlier than is generally conceived; and that instead of its remaining perfect till one-third, or upwards, of the breaking weight was laid on, as is generally admitted by writers (Tredgold on Cast Iron, Article 59, &c.,) it was evident that 1-5th or less produced in some cases a considerable set, or defect of elasticity; and judging from its slow increase afterwards, I was persuaded that it had not come on by any sudden change, but had existed, though in a less degree, from a very early period. I mentioned the fact and my convictions sometime after to Mr. Fairbairn, and expressed a desire to have bars cast of greater length than before to render the defect more obvious.

All the future experiments on a transverse strain, whether made by myself or Mr. Fairbairn, have tended to prove the matter.

We passed over the experiments placed at the beginning of Tables I. and II: referring now to them, it will be seen, that in 3 out of 6 experiments, 16 lbs. produced a visible set, whilst the breaking weights in these cases were 469, 462, 518: in other words, the elasticity was injured with 1-30 of the breaking weight, or less. In experiments 4 and 5, Table I., which were on longer bars than the others, cast for this purpose, and for another mentioned further on, the elasticity in the former experiments was sensibly injured with 7 lbs., and in the latter with 14 lbs., the breaking weights being 364 lbs. and 1120 lbs. In the former of these cases a set was visible with 1-52, and in the other with 1-80 of the breaking weight, showing that there is no weight, however small, that will not injure the elasticity.

In two other bars, from the same model, which were laid against vertical supports at the same distance asunder as before, the force being applied horizontally by means of a pulley, 7 lbs. showed a defect of elasticity in that which had the rib submitted to tension, and 21 in the other.

The mode used to observe when the elastic force became injured was as follows. When a bar was laid upon the supports for experiment, a "straight edge" was placed over it, the ends of which rested upon the bar directly over the points of support. These ends were slides which enabled the straight edge to be raised or lowered at pleasure. In this manner it was easy to bring it down to touch in the slightest manner a piece of wood tied upon the middle of the bar. A candle was then placed at the side of the bar opposite to where the observer stood, by the light of which, distances extremely minute could be observed. Should it be asked why this had not been noticed before, the answer of the writer would be, that most experimenters have used bars shorter in proportion to their depth than are here employed, and therefore the set was much less obvious than here; and in deep bars or beams it is almost imperceptible till the weight laid on is considerable.

From what has been stated above, deduced from experiments made with great care, it is evident that the maxim of loading bodies within the elastic limit has no foundation in nature: but it will be considered as a compensating fact, that materials will bear for an indefinite time a much greater load than has hitherto been conceived.

When a body is subjected to a transverse strain, some of its particles are extended and others compressed; I was desirous to ascertain whether the above defect in elasticity arose from tension or compression, or both. Experiments 4 and 5 show this: in these a section of the casting, which was uniform throughout, was the form

. During the experiments the broad flat part *a b* was laid horizontally upon supports; the vertical rib *c* in the latter experiment being upwards, in the former downwards. When it was downwards the rib was extended, when upwards the rib was compressed. In both cases the part *a b* was the fulcrum; it was thin and therefore easily flexible, but its breadth was such that it was nearly inextensible and incompressible comparatively with the vertical rib. We may therefore assume that nearly the whole flexure which takes place in a bar of this form arises from the extension or compression of the rib, according as it is downwards or upwards. In experiment 4 we have extension nearly without compression, and in experiment 5 compression almost without ex-

tension. These experiments were made with great care, and their results are generally in accordance with those from two others alluded to above, but not inserted. They show that there is but little difference in the quantity of the set, whether it arises from tension or compression.

The set from compression however is usually somewhat less than that from extension, as is seen in the commencement of the two experiments, and near the time of fracture, in that submitted to tension. The deflections from equal weights are nearly the same, whether the rib be extended or compressed, (as was shown by Duleau in experiments upon triangular bars of malleable iron,) but the ultimate strengths, as appears from above, are widely different.

It is to be hoped that the observations made above will obviate objections which have been offered against a form of cast iron beam arrived at by the writer, in a paper alluded to above. From this paper it appeared that a beam bore the greatest weight from the same quantity of metal when the strengths of its bottom and top ribs were as 6 or $6\frac{1}{2}$ to 1, and this was found in the subsequent experiments of the writer to be nearly the ratio of the tensile to the compressive strength of the iron.

To ascertain the correctness or otherwise of the assertion of Emerson, so often shown to be true in theory, that if a small portion be taken from the vertex of a beam whose section is a triangle, the part will be stronger than the whole, castings were formed both from the hot and cold blast iron (experiments 8, 9, 10, in the one, and 8, 9, in the other.) They were all from the same model and ground to the exact size, and the part taken off in the frustums was $\frac{1}{10}$th of the whole height of the triangle. The breaking weights of the whole triangle, in the hot blast iron were 672 and 812 lbs., mean 742 lbs. and of the frustum 728 lbs. In the cold blast iron the whole triangle was broken with 815 lbs., and the frustum with 677. The difference in the transverse strengths of the hot and cold blast Carron irons, No. 2, is very small, the ratio between them being 99 to 100. (See recapitulation at the close of this report.) We may therefore assume their strengths to be the same, and taking an arithmetic mean between all the strengths we have strength of triangle 766 lbs., strength of frustum 702 lbs. The frustum is therefore weaker than the triangle.

It is often asserted by practical men that if the hard skin at the outside of a cast iron bar be removed, its strength, comparatively with its dimensions, will be much reduced; to try this, four bars, $1\frac{1}{4}$ inch square each, were made, two of hot and two of cold blast; they were then planed in the middle to one inch square nearly: their results are in experiments 11 and 12 in Table I, and 10 and 11 in Table II. Their strengths were fully equal to those of bars one inch square, which were cast with them but not inserted.

It is generally admitted that the strength of a rectangular beam, whose length and breadth are given, is as the square of the depth. To ascertain how far this important law agrees with experiment, castings were formed both in the Carron and Devon irons; they were 1 inch broad, and had their depths 1, 3, and 5 inches, the distance between the two supports being as usual, 4 feet 6 inches. It is evident then, that if the strength of each of these beams, when reduced to the exact size, be divided by the square of the depth, the quotient should be the same in each case. Hence, taking the mean reduced strength of the 1-inch bars for the first number in each iron, the reduced strength of the 3-inch bars divided by 9 for the second number, and the reduced strength of the 5-inch bars divided by 25 for the third number, we have

In Carron, No. 2, hot blast . . .	452	427	402
Do. cold blast . . .	453	417	514
In Devon Iron, No. 3, hot blast . . .	537	576	617
Do. cold blast . . .	448	377	405
	472	449	459

If we compare the numbers in each line, they differ widely; but taking the mean, they approach nearly to equality. We may therefore admit that the strength is as the square of the depth.

Table III.

Results of Experiments made to ascertain the Transverse Strength of Devon Iron, No. 3. All the castings were run 5 feet long, as before; they were uniform throughout, and supported on props 4 feet 6 inches asunder. Devon Iron, No 3, made with *Coal* and a Hot Blast.

Experiment 1. Depth of bar 1.00 Breadth of do. 1.00			Experiment 2. Depth of bar 1.09 Breadth of do. 1.01		Experiment 3. Depth of bar 1.50 Breadth of do. 1.50		Experiment 4. Depth of bar 3.00 Breadth of do. 1.03 Weight of do. 48 lbs.		Experiment 5. Depth of bar 4.98 Breadth of do. 1.03 Weight of do. 304 lbs.		Ex. 6.—Uniform beam 5.15 in. deep, with ribs top and bottom, of transverse areas, as 1 : 64. Weight of beam 98 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Weight in lbs.	Deflection in inches.	Weight in lbs.	Deflection in inches.	Weight in lbs.	Deflection in inches.	Weight in lbs.	Deflection in inches.	Set.
112	.20		112	.185	112	.04	896	.068	.002	5402	.089	.002	5857	.05	
168	.30	.002	168	.29	224	.08	1008	.073	.003	6867	.10	.002	6798	.058	
224	.41	.01	224	.40	336	.12	1082	.077	.004	6798	.117		7730	.06	.002
280	.51		280	.50	448	.17	1306	.094	.004	7730	.135	.008	8196	.07	.004
336	.62	.02	336	.61	560	.22	1530	.108	.005	8662	.153		8662	.074	.004
392	.73	.03	392	.73	672	.26	1754	.125	.008	9993	.17	.015	9593	.08	.004
448	.84	.04	448	.85	784	.31	1978	.147	.010	10534	.19		10646	.093	.008
476	.90		504	.99	896	.36	2202	.162	.012	11950	.22		12751	.108	.01
504	.97		560	1.14	1008	.42	2426	.180	.014	14190	.28		14857	.130	
			574	1.17	1120	.47	2650	.200	.017	15758	broke		16963	.150	.011
			588	broke	1232	.52	2874	.218	.019				19068	.17	.014
					1344	.58	3098	.240	.024				20121	.18	
					1456	.64	3322	.261	.026				21174	.195	
					1568	.71	3546	.286	.029				25817	broke	
					1680	.79	3770	.310	.032						
					1792	.85	3994	.333	.040						
					1904	.96	4218	.360	.047						
					2016	1.05	4442	.388	.055						
					2118	1.16	4666	.420	.067						
					2184	broke	4890	.450	.081						
							5114	.495	.100						
							5338	.530	broke						
Broke in half a minute one inch from the middle.			∴ Ultimate deflection=1.20.		∴ Ultimate deflection=1.21.		Broke in about a minute.		∴ Ultimate deflection=.32		Broke by tension, or tearing the lower rib asunder.		

Table IV.

Devon Iron, No. 3, made with *Coke* and a Cold Blast. Distance between the supports as before.

Exp. 1. Depth of bar 1·00 Breadth of do. 1·00			Exp. 2. Depth of bar 1·00 Breadth of do. 1·00			Exp. 3. Depth of bar 1·48 Breadth of do. 1·49			Exp. 4. Depth of bar 1·50 Breadth of do. 1·50			Exp. 5. Depth of bar 2·97 Breadth of do. 1·00 Weight of do. 44½ lbs.			Exp. 6. Depth of bar 4·98 Breadth of do. 1·01 Weight of do. 77½ lbs.			Ex. 7.—Uniform beam 5·13 inches deep, from same model as that in Exper. 6, Hot Blast, Weight of bar, 91½ lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	·19		112	·195		336	·13		336	·13		1120	·083	+	4936	·08		4936	·058	
168	·29		168	·295		448	·17		392	·156	·004	1232	·100	.003	5402	·089	·005	5867	·070	
224	·39		224	·40		504	·20	·003	448	·18	·01	1306	·097		5867	·097	·007	6798	·083	
280	·49		252	·45	·002	560	·22	·005	560	·23	·01	1530	·113	.003	6333	·105		726	·090	002
336	·59	·001	280	.50	·005	672	·27		672	·27		1754	·132	·004	6798	·11		7730	·096	·004
364	·64	·002	336	·59		784	·31		784	·32		1978	·151	·004	7264	·117		9593	·120	·007
392	·68		392	·70	·01	896	·36		896	·37		2202	·168	·006	7730	·127	·01	10646	·135	
420	·73		420	·75		1008	·41		1008	·42		2426	·189	·007	8662	·138	·011	12751	·167	·013
448	broke.		448	·80		1120	·46	·015	1120	·47	·02	2650	·207	·008	9593	·157	·012	14857	·202	·018
						1232	·51		1232	·52		2874	·227		10152	broke.		16963	·240	·030
						1288	·53		1288	·55		3098	·248	·01				19068	·275	·048
									1344	broke.		3322	broke.					21174	·325	·07
																		22227	broke.	
∴ Ultimate deflection = ·78.			Broke in ½ a minute after the weight 448 lbs. had been put on again.			Broke in half a minute after loading.			∴ Ultimate deflection = 58.			∴ Ultimate deflection = ·269.			∴ Ultimate deflection = ·168.			Broke by tension on the bottom rib being torn asunder.		

Results of TABLE III. *reduced to those of Bars* 1 *inch broad, and* 1, 1½, 3, *and* 5 *inches deep.*

		Specific gravity.	Breaking weight in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product $b+d$, or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Experiment 1st, bar 1 inch deep, 4 feet 6 inches span		7251	504	1·97	488·8	22,044,900
Experiment 2nd, bar 1 inch deep,	do.	. . .	570	1·21	689·7	22,902,400
	Mean	. . .	537	1·09	589·2	22,473,650
Experiment 3rd, bar 1½ inch deep,	do.	. . .	1456	1·21	1761·7	
Experiment 4th, bar 3 inches deep,	do.	. . .	5183	·53	2747	
Experiment 5th, bar 5 inches deep,	do.	. . .	15422	·32	4935	

Results of TABLE IV. *reduced to those of Bars* 1 *inch broad, and* 1, 1½, 3, *and* 5 *inches deep.*

		Specific gravity.	Breaking weight in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product $b+d$, or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Experiment 1st, bar 1 inch deep, and 4 feet 6 in. span		7306	448	·78	349·4	23,205,200
Experiment 2nd, bar 1 inch deep,	do.	7265	448	·80	358·4	22,610,200
	Mean	. . .	448	·79	353·9	22,907,700
Experiment 3rd, bar 1½ inch deep,	do.	7340	888	·54	479·5	
Experiment 4th, bar 1½ inch deep,	do.	7251	892	·56	499·5	
	Mean	7295	890	·55	489·5	
Experiment 5th, bar 3 inches deep,	do.	. . .	3389	·272	921·8	
Experiment 6th, bar 5 inches deep,	do.	. . .	10183	·168	1702·3	

The last experiment in both the preceding tables was upon a beam of the best form of section, according to the writer's experiments, (Manchester Memoirs, vol. 5.) the top and bottom rib being nearly in the ratio of the tensile to the compressive forces of the metal, as mentioned above. The intention was to compare the strength of the beam with that of a rectangular one of the same weight, length, and depth. For this purpose the beams were cast uniform throughout, and in comparing the strength of that in the hot blast iron with the mean from the strengths of the two pre-

ceding rectangular beams, reduced as above, we find that the breaking weight of these is 19,108 lbs., and the beam of best form was broke with 25,817 lbs. In the cold blast Devon iron, the difference in strength is much greater. The rectangular beam, from the mean of the two experiments on the beams 3 inches and 5 inches deep, when reduced as above, gives 11,183 lbs. for the breaking weight, whilst the beam of the best form required 22,227 lbs. to break it.

TABLE V.—Results of Experiments to determine the transverse strength of rectangular bars of iron of the quality No. 1, from the Buffery Iron Works, near Birmingham.

All the specimens were cast 5 feet long, and supported upon props 4 feet 6 inches asunder.

Hot Blast Iron.

Ex. p 1. Depth of bar 1·005 Breadth of do. 1·030 Weight of do. 15 lbs. 13 oz.			Exp. 2. Depth of bar 1·000 Breadth of do. 1·010 Weight of do. 15 lbs. 7 oz.			Exp. 3. Depth of bar 1·000 Breadth of do. 1·010 Weight of do. 15 lbs. 4 oz.			Exp. 4. Depth of bar 2·000 Breadth of do. 1·970 Weight of do. 60 lbs. 6 oz.			Exp. 5. Depth of bar 2·000 Breadth of do. 1·980 Weight of do. 60 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	·310	—	112	·315	·018	112	·322	·010	1082	·210	·015	1082	·217	·028
224	·680	·037	224	·660	·045	224	·720	·055	1306	·257	·020	1306	·270	·031
336	1·140	·100	336	1·110	·120	336	1·200	·128	1754	·368	·035	1754	·380	·045
392	1·410	—	392	1·360	·170	392	1·490	·210	2202	·495	·060	2202	·510	·075
448	1·710	·254	441	broke.		413	broke.		2650	·639	·100	2650	·862	·117
483	broke.								2874	·720	·122	2874	broke.	
									2930	broke.				
∴ Ultimate deflection = 1·840			∴ Ultimate deflection = 1·530			∴ Ultimate deflection = 1·570			∴ Ultimate deflection = ·740			∴ Ultimate deflection = ·732		

Results reduced to those of bars 1·000 and 2·000 inch square.

	Specific gravity.	Breaking weight in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product $b \times d$, or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Ex. 1st, bar 1 in. square 4 feet 6 in. span	6938	464	1·84	853·76	13603000
Ex. 2nd, bar 1 in. square, do. do.	7050	437	1·53	668·61	13858000
Ex. 3rd, bar 1 in. square, do. do.	7008	409	1·57	642·13	
Mean	6998	436	1·64	721 50	13730500
Ex. 4th, bar 2 in. square, do. do.	...	2975	·740	2201·500	
Ex. 5th, bar 2 in. square, do. do.	...	2903	·732	2124·996	
Mean	...	2939	·736	2163·248	

TABLE VI.—Results of Experiments on rectangular bars of Buffery Iron, No. 1, continued.

Cold Blast Iron.

Experiment 1. Depth of bar 1·004 Breadth of do. ·900 Weight of do. 15 lbs. 3 oz.			Experiment 2. Depth of bar 1·013 Breadth of do. 1·014 Weight of do. 15 lbs. 7 oz.			Experiment 3. Depth of bar 1·010 Breadth of do. 125· Weight of do. 15 lbs. 15 oz.			Experiment 4. Depth of bar 2·00 Breadth of do. 1·99 Weight of do. 61 lbs.			Experiment 5. Depth of bar 1·98 Breadth of do. 1·98 Weight of do. 60½ lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
105	—	·010	105	—	·005	86	—	—	1082	·185	·014	1082	·187	·017
112	·28	·011	112	·278	·008	93	—	·003	1306	·235	·020	1306	·23	·02
224	·612	·050	224	·587	·036	112	·275	·006	2754	·332	·036	1754	·338	·037
336	1·00	·105	336	·953	·083	224	·610	·046	2202	·44	·055	2202	·435	·058
392	1·22	·150	448	1·39	·170	336	1·00	·100	2650	·56	·08	2950	·55	·084
448	1·46	·210	455	broke.		392	1·23	·150	2874	·629	·10	2874	·617	·100
490	broke.					448	1·49	·217	3042	broke.		3098	·69	·123
						483	broke.					3322	·774	·15
∴ Ultimate deflection = 1·60.			∴ Ultimate deflection = ·141.			∴ Ultimate deflection = 1·61.			∴ Ultimate deflection = 6·74.			Broke in about a minute after the weight 3322 lbs. had been put on.		

Results reduced to those of bars 1·000 *and* 2·000 *inch square.*

	Specific gravity.	Breaking weights in lbs. (b).	Ultimate deflection in inches (d).	Product $b \times d$, or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Ex. 1st, bar 1 in. square, 4 feet 6 in. span	7086	491	1·60	785·60	15716100
Ex. 2nd, bar 1 in. square, do. do.	7090	437	1·43	624·91	15046300
Ex. 3rd, bar 1 in. square, do. do.	7061	462	1·63	753·06	
Mean	7079	463	1·55	721·19	15381200
Ex. 4th, bar 2 in. square, do. do.	...	3057	·674	2060·418	
Ex. 5th, bar 2 in. square, do. do.	...	3424	·766	2622 784	
Mean	...	3240	·720	2341·601	

General Abstract of Transverse Strengths.

In the following abstract the transverse strengths of hot and cold blast irons to bear pressure and impact will be given, together with the ratio of these strengths.

The comparison will be made between the results of bars from the same models, taking the reduced results, where such reduction has been made.

Carron Iron No. 2.

Strength of Irons.				Power to bear impact.		
	Cold Blast Iron.	Hot Blast Iron.	Ratio of strengths. The strength of Cold Blast Iron being represented as 1000.	Cold Blast Iron.	Hot Blast Iron.	Ratio. The power of Cold Blast being represented as 1000.
Results reduced.	492	469	1000 : 953·2	686	677·2	1000 : 987·1
	509	456	1000 : 895·8	711	649·3	1000 : 913·2
	429	465	1000 : 1083·9	493	532·0	1000 : 1079·1
	449	475	1000 : 1057·9	1481	1598·7	1000 : 1079·4
	457	429	1000 : 938·7	2601	2744·2	1000 : 1055.0
	3750	3843	1000 : 1024·8	141	154	1000 : 1092·2
	10362	10957, 9149 } 10053	1000 : 970·1	3391	3087	1000 : 910·3
				530	452	1000 : 852·8
				359	458·6	1000 : 1277·4
		Mean	1000 : 989·1		Mean	1000 : 1005·1
Results not reduced.	266	280	1000 : 1052 6			
	1050	980	1000 : 933 3			
	815	672, 817 } 742	1000 : 910·4			
	677	728	1000 : 1075·0			
		Mean	1000 : 992·8			
		General Mean	1000 : 990·9			

Devon No. 3 Iron.

448	504	1000 : 1125·0	353·9	589·2	1000 : 1664·8
448	570	1000 : 1272·3	489·5	1761·7	1000 : 3598·9
890	1456	1000 : 1635·9	921·8	2747	1000 : 2980·0
			1702·3	4935	1000 : 2899·0
3389	5183	1000 : 1529·3			
10133	15422	1000 : 1521·9		Mean	1000 : 2785·6
	Mean	1000 : 1416·9			

Buffery No. 1 Iron.

491	464	1000 : 945·0	721·19	721·5	1000 : 1000·4
437	437	1000 : 1000·0	2341·6	2163·2	1000 : 923·8
462	409	1000 : 885·7		Mean	1000 . 962·1
3057	2975	1900 : 973·1			
3424	2903	1000 : 850·1			
	Mean	1000 : 930·7			

Having now subjected the irons which are tried in this paper to a variety of strains, and given the results under their proper heads; a summary of the whole will be added, with remarks to show the general bearing upon the question of Hot and Cold Blast Iron.

Recapitulation.

Taking only the means from all the experiments in the present paper, and attaching to each value a number, in a parenthesis, indicative of the quantity of experiments from which it has been derived, we have as below:

Carron Iron No. 2.

	Cold Blast.	Hot Blast.	Ratio representing Cold Blast by 1000.	
Tensile strength in lbs. per square inch.	16683(2)	13505(3)	1000 : 809	
Compressive strength in lbs. per inch from castings torn asunder,	106375(3)	108540(2)	1000 : 1020	Mean 997
Do. from prisms of various forms,	100631(4)	100738(2)	1000 : 1001	
Do. from cylinders,	125403(13)	121685(13)	1000 : 970	
Transverse strength from all the experiments,	(11)	(13)	1000 : 991	
Power to resist impact,	(9)	(9)	1000 : 1005	
Transverse strength of bars one inch square in lbs.,	476(3)	463(3)	1000 : 973	
Ultimate deflection of do. in inches,	1.313(3)	1.337(3)	1000 : 1018	
Modulus of elasticity in lbs. per square inch,	17270500(2)	16085000(2)	1000 : 931	
Specific gravity,	7066	7046	1000 : 997	

Devon Iron No. 3.

Tensile strength,		21907(1)	
Compressive strength,		145435(4)	
Transverse do. from the experiments generally,	(5)	(5)	1000 : 1417
Power to resist impact,	(4)	(4)	1000 : 2786
Transverse strength of bars one inch square,	448(2)	537(2)	1000 : 1199
Ultimate deflection do.,	.79(2)	1.09(2)	1000 : 1380
Modulus of elasticity do.,	22907700(2)	22473650(2)	1000 : 981
Specific gravity,	7295(4)	7229(2)	1000 : 991

Buffery Iron No. 1.

Tensile strength,	17466(1)	13434(1)	1000 : 769
Compressive do.	93866(4)	86397(4)	1000 : 925
Tranverse do.,	(5)	(5)	1000 : 931
Power to resist impact,	(2)	(2)	1000 : 963
Transverse strength of bars one inch square,	463(3)	436(3)	1000 : 942
Ultimate deflection do.,	1.55(3)	1.64(3)	1000 : 1058
Modulus of elasticity do.,	15381200(2)	13730500(2)	1000 : 893
Specific gravity,	7079	6998	1000 : 989

Coed-Talon Iron No. 2.

Tensile strength,	18855(2)	16676(2)	1000 : 884
Compressive do.,	81770(4)	82739(4)	1000 : 1012
Specific gravity,	6955(4)	6968(3)	1000 : 1002

Carron Iron No. 3.

Tensile strength,	14200(2)	17755(2)	1000 : 1250
Compresive do.,	115442(4)	133440(3)	1000 : 1156
Specific gravity,	7135(1)	7056(1)	1000 : 989

Of the three columns of numbers in the table above, the first is the strength, or other quality, in the cold blast iron; the second is that in the hot blast; and the third is the ratio of these quantities.

The results in this table contain nearly the whole information relative to the question of hot and cold blast iron that the preceding research affords; and before adverting to them it may be mentioned that it is usual for the makers of cast-iron to divide it, when taken from the furnace, into three classes, called Nos. 1, 2, 3, differing from each other in the appearance and qualities of the material. No. 1 contains the softest and richest irons, those which have the largest crystals; No. 3, the hardest and densest irons, those with the least crystals; and No. 2, irons intermediate between the former two descriptions. Beginning with the No. 1 iron, of which we have a specimen from the Buffery Iron Works, a few miles from Birmingham, we find the cold blast iron somewhat surpassing the hot blast in all the following particulars—direct tensile strength, compressive strength, transverse strength, power to resist impact, modulus of elasticity or of stiffness, specific gravity; whilst the only numerical advantage possessed by the hot blast iron is that it bends a little more than the cold blast before it breaks.

In the irons of the quality No. 2 the case seems in some degree different; in these the advantages of the rival kinds seem to be more nearly balanced. They are still, however, rather in favour of the cold blast.

Referring to the No. 2 iron, from the Carron Works in Scotland, we find the tensile, compressive, and transverse, strengths, together with the modulus of elasticity and specific gravity, all higher in the cold blast iron than in the hot blast, whilst the ultimate deflection and power of sustaining impact are greater in the hot blast. The cold blast iron is the better, but the difference is very small.

In the iron No. 2, from the Coed-Talon Works in North Wales, the tensile strength is greater in the cold blast than in the hot; but the resistance to compression is higher in the latter than the former, and that is the case with the specific gravity.

So far as my experiments have proceeded, the irons of No. 1 have been deteriorated by the hot blast; those of No. 2 appear also to have been slightly injured by it, whilst the irons of No. 3 seem to have benefitted by its mollifying powers. The Carron iron No. 3, hot blast, resists both tension and compression with considerably more energy than that made with the cold blast; and the No. 3 hot blast iron from the Devon Works, in Scotland, is one of the strongest cast-irons I have seen, whilst that made with the cold blast is comparatively weak, though its specific gravity is very high, and higher than in the hot. The extreme hardness of the cold blast Devon iron above, prevented many experiments that would otherwise have been made upon it, no tools being hard enough to form the specimens. The difference of strength in the Devon irons is peculiarly striking.

From the evidence here brought forward, it is rendered exceedingly probable that the introduction of a heated blast into the manufacture of cast iron has injured the softer irons, whilst it has frequently mollified and improved those of a harder nature; and considering the small deterioration that the irons of the quality No. 2 have sustained, and the apparent benefit to those of No. 3, together with the great saving effected by the heated blast, there seems good reason for the process becoming as general as it has done.

Additional evidence will be obtained from the experiments in the next paper.*

Progress of Manufactures on the Continent of Europe.

The following information on the above important subject is extracted from a very able work, entitled "Arts and Artizans at Home and Abroad; with Sketches of the Progress of Foreign Manufactures." By JELINGER SYMONS, Esq. We would observe, that the statements of this gentleman are entitled to the more attention, from the peculiar facilities he enjoyed of obtaining the most authentic information in his capacity of assistant commissioner of the hand-loom inquiry:—

"Machinery is the main agent for manufactures, and no surer index of the progress of the latter can be adduced than the advances of the former. I am, I confess, not among the number of those who magnify the relative importance of the existing circumstances and extent of foreign competition; but I should be wilfully blind to the plainest evidences of the truth, were I to conceal that there are symptoms throughout the continent of a prospective, and by no means a remote rivalry with this country in the chief of those arts of production and elements of commerce in which England has heretofore maintained a perfect and facile pre-eminence. The peril to this country is to be measured not by present competition, but by the magnitude of the preparations, and the germs of a progress which is, as yet, confined to a promising and vigorous infancy, evidenced chiefly by the rapid increase of machine-making establishments, to a slight description of which I shall devote this chapter. Belgium, from her mineral riches and other topographical facilities, naturally takes the lead in the progress of continental machinery. I have already alluded to the leviathan establishment of Mr. John Cockerill, at Seraing, employing 3000 workmen, with seven skilful English engineers superintending the chief departments, and combining English skill with the advantage of cheap labour. The motive power consists of steam engines of 900 horse power; and Mr. Cockerill not only supplies machinery to all parts of the continent, but has branch establishments in three different countries. In addition to spinning machinery of every description, steam engines, both stationary and locomotive, are supplied to France, Germany, and Russia. It is difficult to name any large enterprise of manufacturing industry, whether in Belgium, Holland, Russia, or the immense territory of the Prussian league, with which Mr. Cockerill is unconnected, either as a shareholder, or as the engineer from whom the machinery emanates. He has spinning mills of flax, or cotton, or wool, in almost all the chief districts for these manufactures in the Prussian and Belgian dominions. Mr. Cockerill's name is on all the locomotive engines on the Belgian rail roads, and I was told that he is the contractor for those now forming in Prussia. When we remember that Mr. Cockerill's father, who established this gigantic concern, came over to Belgium a common blacksmith, and could neither read nor write, I believe, till the day of his death; when we further consider that the machinery he turns out is, after all, of secondary reputation for quality, and extremely dear, we may form some idea of the power and magnitude of the natural advantages Belgium affords to the manufacture of machinery, and which

* The paper of W. Fairbairn, Esq. will be continued in the next number.

may be reckoned as the multiplier of all her other productive powers. Mr. Cockerill, extensive as are his enterprises, by no means monopolises the making of machinery. Of those now commencing there are the Messrs. Fairbairn, who have issued prospectuses of an establishment which was to be formed at the large factory already built at Malines, near the rail road station. Mr. William Fairbairn is to superintend the heavy department for engines, locomotives, &c., and Mr. Peter Fairbairn that for spinning machinery, and especially for flax spinning. There can be no question that this establishment will rival any in England. In addition to these is the company of the Phœnix, at Gand, on a very large scale, and in which English and Scotch engineers are already engaged. There is likewise another at Brussels, of the existence of which some mystery is made. I owe the knowledge of it to Sir Hamilton Seymour, who kindly accompanied me to see it, and, owing to his good offices, we obtained the unusual favour of being allowed to inspect the interior. It is of large dimensions, covering two bonniers and a half, of about 6500 square feet each. This establishment belongs to one of the *sociétes anonymes*, of which the Banque Nationale is said to be at the head. Five hundred workmen, of nearly all nations except France, whose operatives are not in repute in Belgium, are employed. Some of Sharp and Roberts's machinery was there. The present motive power is not above 36 horse. There are several old established machine makers in different towns in Belgium, but few on the same scale as those I have named. The fact is, that this industry is yet in the first stage only of its development. Mr. Cockerill told Sir Hamilton Seymour that he had all the new inventions over at Seraing ten days after they came out in England. There is but one chance of an obstacle to the career of Belgium in her manufacturing progress of competition with England, and that one her Majesty's government have recently, no doubt with the best intentions, used their best exertions to remove—exertions which have met with the best reception and success on the part of Belgium. I allude to the decreasing stock and increasing price of coal in that country. The following table of its rapid rise in price is extracted from statistical government returns:—

	1836.	1837.
Mons	7 and 8 fr. per tonne	12 and 14 fr. per tonne,
Charleroi	13 and 14 fr. do.	18 and 19 fr. do.

Prior to 1836, Mons coal was 8 fr. per tonne at the *maximum*. It has risen in price since last year; and the Belgian government have, consequently, assented to the prayer of the English government, to be allowed to supply them free of duty. By France a similar boon has been granted to the coal owners in England, and I need hardly say that the Belgian and French manufacturers are overjoyed at the concession. The iron works make equal progress in Belgium. In 1837 there were twenty-three high furnaces of coke, and sixty-six of charcoal, in Belgium. Twenty new furnaces of coke are either completed, or being erected since that period. On the plain of Selessin, near Liege, a company are erecting six, of a colossal magnitude, which, when finished, will be the largest on the continent. The quantity of iron founded in the year in Belgium was estimated at 150,000 tonnes (or about 147,640 English tons). It is now increased. The following are the current prices of iron per tonne:—

	Francs First quality.	Francs Second quality.
1830	465	390
1832	412	322
1834	393	304
1836	413	324

"In France machine making is proceeding with considerable rapidity. Mr. Dyer, of Manchester, has established his son at Blangy, not far from Abbeville, and there are many French competitors. There is one, especially, at Rheims, who turns out excellent machinery, and many at St. Etienne. At Zurich, in Switzerland, there is a first rate establishment of this sort, where iron steam boats, down to the finest spinning machinery, are manufactured. There are nearly 700 workmen employed here, and seven are English foremen. Mr. Escher, who is one of the first and most scientific industrialists of the continent, is at the head of this establishment, and, like Mr. Cockerill, is also the proprietor of several flourishing steam factories, some paper mills, some weaving, and some spinning, mills, not only in Switzerland, but in Piedmont, Savoy, the Tyrol, and Wirtemberg, where he is about to erect a flax factory. Mr. Peter Kennedy, late of Manchester, is in partnership with him, and superintends the Austrian mills. New inventions are frequently made. For instance, I saw a roller introduced at the end of the carding frames, round which the cards are wound, and which dispenses entirely with the pans, and, consequently, with a great number of hands, still employed in most, if not in all, of the English mills. Again, they are enabled to unite the separate advantages of different patents in England; and at Mr. Escher's factory, in Zurich, I saw a combination of the self-acting mules severally produced by Sharp and Roberts, and Mr. Smith of Deanston, and which their patents prevent our combining in England. Many of the foreign mechanics, who have not an equal skill in the invention or improvement of machinery, directly pirate the productions of English skill. An English gentleman told me he had assisted in putting together some new machinery in Italy, which had been cast in moulds formed from some smuggled machinery of the Messrs. Crichton, with their name and the word 'Patent' cast on it. At Vienna, the Emperor has a large establishment under his immediate patronage, and an Englishman of the name of Thompson, is one of its chief superintendents. The Emperor of Russia has very large foundries and spinning factories at Alexanderoffsky, with a General Clark at the head of the foundry, and a Mr. Wilson of the factories, and at Colpenny, with several English workmen. Wilson, brother of the above named, is the foreman or superintendent at St. Petersburgh; the foundry is chiefly for cannon. John Isherwood, formerly of Leeds, is at the head of another establishment called Waybugskey, a part of the capital. The following information on the denizen mechanical skill in Poland, is from a perfectly authentic source. A large mill, having sixteen pair of mill-stones, moved by steam power, and lighted with gas, was erected at Warsaw some years ago. It was at first managed by a native of France, under whose management it did not succeed. For the last six years, a Mr. Kedslie, mill factor, from Leith, has been the superintendent, and he has taken out two millers and their families from the mills on the Water of Leith: the mill is now working day and night, and succeeding well. All parties concerned there are said to be much pleased that the bill to grind bonded grain has been

thrown out by the British House of Commons. They fear nothing so much as British capital, machinery, and skill to compete with them. John Douglas and nephew, from Edinburgh, established thrashing machines and paper mills in Poland, and have now settled as paper mill proprietors in that country.

"Since the last rebellion in Poland, James Garvie and Son, also Thomas Garvie, shawl manufacturers, from Edinburgh, have succeeded in establishing a shawl manufactory thirty miles from Warsaw, upon the estate of Count Lubenskie, President of the Board of Trade there: the factory consisted of thirty looms in the month of September, 1836. This same Count has erected a spinning mill for flax, 300 feet long, 100 feet wide, three flats in height, and has 200 looms at work, weaving table cloths, towelling, and linens; also thirty shawl looms in the month of September, 1836: the yarn all spun by his own mill. Thomas Garvie has engaged to be his overseer for the weaving department, and left the shawl factory to his brother James and son, who are doing well. Mr. Pritchard, from Edinburgh, now engineer to the government zinc mines in Poland, was in Scotland two years ago, at which time he engaged a bleacher from Perthshire, who has commenced bleaching in the above establishment. This is the first attempt at bleaching in Poland. Mr. George Blackie, engineer from Edinburgh, is now employed on canals and public roads by the Government of Poland. At Prussian Bohemian, at Aix, in Prussia, and in Saxony, at Chemnitz, there are also machine-making establishments. In fact, they are rising in all parts of the continent with a rapidity and to an extent very far disproportioned either to the growth of the population or to the progress of preceding years. English machinery is smuggled abroad in considerable quantities, at a charge of 75 per cent., and sometimes for less. The increase of machine makers abroad, and the emigration of English artisans, will, however, soon tend, unfortunately for us, to diminish this traffic; for the very limited number of machine makers who have, till within the last two years, been established abroad, has hitherto tended to give them monopoly prices. Seeing the utter inefficiency of our laughable prohibition on the exportation of machinery (driven by a screw of an inch and a half diameter), it is much to be lamented that this protection and encouragement, afforded by the smugglers' high per centage, should be given to foreign machine makers, to the manifest injury of that branch of our own industry, without, in the slightest degree, benefiting the factories it is designed to protect. There are few absurdities of our custom house legislation which it is more urgently incumbent on the government to abolish. If a free exportation of foreign machinery were to take place, I have not the slightest doubt that the foreign machine makers would be crippled, and that we should largely increase our own trade in machinery—one, I may be permitted to remark, to which it is the policy of this country to give the fullest scope, as it is manifestly that in which we pre-eminently possess territorial and artistical capacity to excel, far surpassing that of any other nation. However, as long as we protect the machine maker abroad, to the injury of the machine maker at home, we must expect to see a rapid increase of this industry abroad; one, be it ever remembered, which is the prolific parent of every other; and, what is still worse, we must expect to see more of our Dyers, Fairbairns, and Cockerills preparing to follow their predecessors in transferring their skill and capital from the employment of home, to foreign labour. I was debating the proposed imposition of a duty on our flax yarn by the French government, with one of our leading manufacturers of France,

Mons. Delasalle, of Lille, 'And how,' said he, 'can your government have the face to talk to us about the impolicy of protecting our home industry, when it goes the tenfold greater length of prohibiting even the exportation of the articles which may indirectly aid the industry of another country? Let England abolish her prohibition on the export of machinery—let her abolish a protecting law of her own, more stringent and illiberal than that of any other nation in Europe, before she talks to us of the benefits of a free trade.' Mons. Delasalle is President of the Chamber of Commerce at Lille, and in constant communication with the government on these subjects. We had a very long discussion on the general policy of free trade. He adheres rigidly to the protective system, but not without many manifest misgivings in his own mind." Mining Review.

Upon the mode of determining the quantity of Copper in ores and smelting products, by the humid way. By Ch. Kersten, *Professor of Chemistry and Metallurgy in Freyberg.*

The copper assay by the dry way belongs to those operations of assaying from which it is desired that the most true and accurate results may be given, but it proves imperfect in the examination of ores and smelting products, which yield only few per cent. of copper, and which, besides, consist of nickel, cobalt, iron, antimony, and other metals of this kind; therefore, if the question was to learn the real richness of copper in any ore or smelting product, I have always chosen the humid way, and precipitated the copper from the solutions of substances under examination, by employing sulphuretted hydrogen. The sulphuret of copper, it only small quantities of it were obtained, was converted into an oxide by calcination, under the cover of a muffle; if more, then it was digested with aqua regia, and the dissolved oxide of copper was precipitated on introducing caustic hydrate of potass into the heated liquid. But this process is rendered still more complex, should the substance contain lead or silver (without the removal of which from the solution, the precipitation of pure copper cannot possibly take place,) and loses much in accuracy and exactness, should, in addition to the already named metals, antimony and arsenic, be contained in the substances, whose richness in copper is to be determined, as, for instance, in *bleystein*, containing copper and other metals.

The more satisfactory was it, on this account, for me to become acquainted with the process introduced in the laboratory of Mr. Sefstrom, and the Gustav silver smelting house, at Fahlun, for determining the quantity of copper in copper ores, which, from the experimental assays I have since made, proves itself so admirably adapted for the purpose, not only enabling the assayer to find out the quantity of copper contained in ores of poor quality, but also in ascertaining the same, with the greatest ease and accuracy, in copper, scoria, &c. The process consists, in general, of the treatment of the substances containing copper, with concentrated sulphuric acid, and precipitating the solution obtained with metallic iron.

Although it may seem to require but little explanation, the success of an assay will be found to depend much on address, and a strict observance of the rules practice has laid down is strongly to be recommended. I take the liberty, therefore, of communicating the process, which at the present time is adopted in the Metallurgical Laboratory in Freyberg for determining the richness of copper in ores and scoria. In order to obtain an ave-

rage assay of the ore or product, any discretionary quantity is to be pounded in a mortar, the same as every other copper assay. A small portion of the powder is then again pounded in a mortar of steel or calcedony, and from three to five grammes* taken away and weighed; this powder is now put into a bolt-head, the neck of which must be broken off, having a height of from two and a half to three inches, and then mixed with three-fourths of an ounce of concentrated sulphuric acid. In order to avoid weighing the sulphuric acid, we make use of a pipette, with India rubber. Any number of such bolt-heads are placed in the sand bath, which is filled an inch in depth with sand, and stands either in the open air or in a good draught. The fire under the sand bath is to be gradually increased till the sulphuric acid boils, and till all steam from the sulphuric acid disappears, and the mass has become dry: from six to twelve hours, according to the nature of the substances to be assayed, will be found necessary; into each bolt-head, one then pours twenty drops of sulphuric acid. After half an hour's digestion, the mass in the bolt-head can be poured over with hot boiling water, and then rinsed in a warmed precipitate glass. While the fluid is still hot, filter it likewise in a heated precipitate glass, and pour boiling water on the insoluble sediment till the whole solution amounts to 2 lbs. The precipitation of copper now takes place. We make use of an iron or steel plate, from eight to nine inches long, filed square, and about a quarter of an inch thick; on this occasion, however, before employing the same, it must be wrapped up in paper and laid in the sand bath to get hot. As soon as the hot copper solution is stirred with the bar, a strong ebullition of the hydrogen gas follows, and metallic copper will be precipitated. During the precipitation one must cover the precipitate vessel with a plate of glass. If no more hydrogen gas is evolved, and the previous greenish blue solution has become colourless, which generally takes place in one hour to one and a half, the precipitation which must take place in the sand bath is completed. If the fluid has been properly thinned, and reddened the litmus paper, and is hot, no copper generally will be found attached to the iron bar, it having detached itself and fallen to the bottom of the precipitate glass. The iron appears, as far as it has been immersed in water, to have covered itself with a thin coat of carbon. We transfer the same with a camel-hair brush into the liquid, and after washing it in this manner, dry, and quickly polish it with a fine file. The liquid is now decanted from the precipitate glass in which the copper lies, as long as the same can be managed without loss, and the precipitate glass is again filled with hot water, till the copper, by this process, has become quite pure. Through repeated decantation all particles of carbon which have loosened themselves from the iron plate during the precipitation of the copper will be entirely separated from the last, and appear as a uniform powder, of a beautiful red copper colour. After the last cleaning of the filter, we brush the copper with a fine camel-hair brush, or the beard of a quill, into a prepared filter, dry the same at 100 degrees, and determine the weight of the metal. With small quantities of copper, instead of filtering, I wash it in a previously weighed watch glass, drawing off the small quantity of water by a pipette. I let the rest evaporate, and then weigh the metal after drying it; the sooner this takes place the better, as the metal is easily affected by the moisture of the air. A precaution necessary to be observed in the management of the operation above described, is the avoiding of all such circumstances as tend to produce or

* The gramme is equal to 15,444 English grains.

accelerate a higher degree of oxidation of the dissolved iron in the solution. It is, therefore, indispensably necessary, as I have many times convinced myself, in order to insure success to the experiment—

1. That hot water, as free from air as possible, be used to soften said ore that has been treated with sulphuric acid.

2. That the solution of copper be highly diluted, and redden litmus paper. The precipitation of copper is hastened by adding a few drops of sulphuric acid to the liquid.

3. That the precipitation be made while it is warm.

4. That the iron be well polished and heated before using.

5. That the precipitated copper be quickly removed from the liquid above it, and in washing the same hot water be used. A copper assay of the above description requires two days for performance; one can, however, very conveniently, during this time, prepare twenty-four; when one has several of the same to make at once, it is advisable, in filtration, to make use of a shelf similar to that used with the re-agent glasses, on which each individual hole for the reception of the funnel is numbered. It is also desirable, to avoid confusion, to number the glasses in which the copper is precipitated. Should it be wished to determine the richness in copper, of copper-slate through these means, which are well suited for the purpose, it is necessary to heat the same red-hot, in order to drive off the bitumen. If it is supposed that the substance may not be perfectly decomposed by the sulphuric acid, for safety's sake we might put some drops of *aqua regia* to the dried up mass, before it is mixed with a second portion of sulphuric acid. This will happen, however, very seldom, for all those ores and smelting products I had the opportunity of trying, by this method, were always perfectly decomposed by the sulphuric acid, after they had been ground to powder, and a sufficient quantity of sulphuric acid applied; also, when the washed residuum was treating in solution with aqua regia, I never could detect the least signs of copper, examining and treating the solution with ferro cyanite of potassa, ammonia, and iron. If metallic sulphur, as, from the lead process (bleystein and bleispelse,) containing copper, are submitted to this assay, the component parts of lead and iron give in the state of sulphate, a white or yellow residuum, so that the solution will scarcely contain any thing else but sulphate of copper. Ibid.

Fontainemoreau's *new Alloys of Zinc—a substitute for Bronze, Copper, and Brass.*

An invention of a new alloy of zinc, with small proportions of other metals, found to possess very peculiar advantages, has lately been introduced into England, where it has been patented in the name of M. Lacomte de Fontainemoreau. It is likely to prove of great utility in the manufacture of machinery; and in castings relating to the fine arts, as a substitute for copper and bronze, will be extensively adopted. We suggested it as a material for casting the Nelson memorial, and we beg to reiterate the suggestion to the various committees now engaged in the formation of that, and other national testimonials.

The proportions of metals which have been found most advantageous in forming varieties of the alloy, after very numerous and extensive experiments, are as follows:—

No. 1.	
Zinc,	90 parts.
Copper,	8 "
Cast Iron,	1 "
Lead,	1 "
	100 parts.

No. 2.	
Zinc,	91 parts.
Copper,	8 "
Lead,	1 "
	100 parts.

No. 3.	
Zinc,	92 parts.
Copper,	8 "
	100 parts.

No. 4.	
Zinc,	99 parts.
Copper,	1 "
	100 parts.

No. 5.	
Zinc,	97 parts.
Copper,	2½ "
Cast Iron,	½ "
	100 parts.

No. 6.	
Zinc,	97 parts.
Copper,	3 "
	100 parts.

No. 7.	
Zinc,	99½ parts.
Cast Iron,	½ "
	100 parts.

No. 8.	
Zinc,	91½ parts.
Copper,	8 "
Cast Iron,	½ "
	100 parts.

The stated proportions of any of these metals may be slightly varied, so long as by such variation the alloy is not made too brittle or too soft; for instance, the proportion of copper may be varied from about one part to about twelve parts in every hundred, but any greater proportion of copper than this, and less than that used in forming common brass, would make the alloy brittle. The proportion of cast iron may be varied from about one-quarter of a part to about two parts in every hundred. The proportion of lead may be varied from about one to twenty-four parts in every hundred parts, but the presence of some third metal is necessary to produce a proper combination of the zinc and lead. Instead of pure copper or any other of the simple metals directed before to be used, brass or other alloys formed of these metals may be used; but where this is done, the quantity of copper and other simple metals contained in such alloys must be taken into account in calculating the relative proportions of simple metals which the new alloy is to contain in reference to the tables of component parts.

The principal object of the addition of the small quantities of copper, cast iron, and lead, to the larger proportions of zinc, is to change the manner of the crystallization of the zinc, after it has been fused and set to cool.

The new alloys are of a closer texture, more homogeneous and malleable than simple zinc, and some kinds of iron; are less liable to oxidation, and of a much finer grain than zinc, somewhat resembling that of steel, especially when the alloys are rolled; they are also easier filed than either zinc, copper, or brass, and the filings do not stick in and clog the file.

By casting the new alloys in metallic moulds, their hardness and homo-

genity is increased, and a sort of temper is imparted to them, resembling, or approaching to, the temper of steel.

For the purpose of rendering the alloys, which are of a silvery grey colour, perfectly suitable as substitutes for copper, bronze, brass, and other metals, the colours proper to the metals of which they are intended to be substitutes, is imparted to them by means of any solution of copper. The hydro-chlorate of copper is found to answer best.

Firstly, for giving the alloys a blackish bronze colour, they are treated with a solution of the salt of copper, diluted with a considerable quantity of water, and a small quantity of nitric acid may be added. Secondly, to impart a red or copper colour, add to the solution of salt of copper, liquid ammonia, and a little acetic acid; the salt of copper may be dissolved in the liquid ammonia. Thirdly, to impart a brass or antique bronze colour, either of the three following means may be adopted: first, a solution of copper with some acetic acid; second, the means above described for copper colour, with a larger proportion of liquid ammonia; third, water acidulated with nitric acid, by which beautiful blueish shades may be produced. It must be observed, however, that this last process can only be properly employed on the alloys which contain a portion of copper. In either of these methods of colouring, a solution of sal ammoniac may be substituted for the liquid ammonia. The quantities of each ingredient have not been stated, as these depend on the nature of the alloy, the shade or hue desired, and the durability required.

The blackish bronze colour may be superadded to the red or copper colour, whereby a beautiful light colour is produced on the prominent parts of the article bronzed, or on the parts from which the blackish bronze colour may have been rubbed off.

These new alloys may be used as substitutes for various metals now in general use, such as iron in various parts of machinery; iron, lead, tin, or copper, in pipes and tubes; and bronze, brass, and copper in machinery and manufactories, as well as for most of the other purposes for which more expensive metals are employed. Mech. Mag.

Geary's Patent Coal.

The formation of an artificial fuel has for some time past occupied no small portion of the attention of scientific minds. The high price of the natural mineral—the great space it requires for stowage—the quantity of its refuse, and the nuisance of its smoke, were amongst the disadvantages which it was sought to be overcome by some artificial combination of combustible matters. We have from time to time published accounts of the various patented methods of manufacturing artificial fuel and coal, and of various experimental usings thereof for steam-engines and other purposes, to which we have now to add, the particulars relating to another composition invented by Mr. Stephen Geary the architect.

Mr. Geary's artificial coal consists of a mixture of the following ingredients:—First, about half of small coal, or coal-dust; second, pitch, or bituminous matter obtained from coal, or other mineral or vegetable tar; third, coal or coke cinders, powdered peat, or bark of trees, sawdust or tan; fourth, powdered clay, freestone, chalk, plaster, earth, sand, or other earthy matters; and lastly, about a fortieth-part of some acid—sulphuric acid, as the cheapest, is that which is used by Mr. Geary.

The coal is manufactured in the following manner:—The pitch is to be

mixed in a pot, and the cinders gradually introduced—stirring constantly. The powdered clay is next to be added gradually, then one-half of the small coal, as soon as these matters are well amalgamated—being kept at a good heat during the operation—the acid is to be poured in, and well stirred through. An effervescence will in a short time take place, producing a froth on the surface of the mixture; and as soon as this appears, add the remainder of the small coal. The mixing of the ingredients having been complet-ed, the fluid mass must be kept in a state of agitation by stirring until the whole is well and equally heated. The mixture may then be run into moulds of any desired shape. When the mixture has become partially cool, pres-sure or beating may be applied in order to compress the blocks of fuel into as small a compass as possible. The pressure or beating is not essential, ex-cept in cases where the coal is intended to be used as steam-boat fuel, where stowage room is valuable.

The ingredient in this composition, which is new, and from the action of which on the other component parts, the beneficial qualities of Mr. Geary's fuel result, is the acid; and he claims the addition of an acid or acids to the other matters which have all been used before, as constituting his patent.

Some specimens of coal fuel manufactured were submitted to Professor Brande for his examination and opinion, who reported as follows:—

"That it burns well, kindles readily, and has most of the characters of some of the bituminous coals. It undergoes combustion rather more rapid-ly than the ordinary Newcastle coal, but appears to give out as much heat, and to form a brisk, agreeable, and efficient fire, and I apprehend no objec-tion to it on the score of smell, dust, smoke, soot or ashes, and it is entirely free from any quality prejudicial to health.

"I have no doubt that it might be available in the manufacture of gas and coke, but whether economically or not is a question which I have no means of determining.

"Accurately to ascertain the relative value of this fuel, as compared with the ordinary varieties of coal, would require a series of experiments upon a larger scale than I have been enabled to undertake, but from the trials which I have made of it, it appears to me to compete with the superior kinds of coal, and if so, the greater number of its applications to inferior purposes are matters of comparatively little moment."

Mr. Squire (chemist in ordinary to her Majesty) also reports very favour-ably of its merits in the following terms:—

"I have examined the properties of the Patent Coal, which you placed in my hands for that purpose, and have to report that it makes a cheerful fire in the open grate, the temperature of the room being more steadily in-creased, and the maximum of heat longer retained by it than with common coal, and although it does not throw out so violent a heat as the best screened coals, yet it has the advantage, I feel alone, of continuing to burn till all is consumed to ashes, leaving no cinders; it is entirely free from any unplea-sant smell, and when burnt in close vessel it yields nearly the same quantity of coke as the best coals do, and the gas given off burns with great brilliancy."

These favourable opinions, we are happy to be able to say, have been confirmed by subsequent experience. The Commercial Steam Boat Com-pany, in consequence of the beneficial result of some experiments they made, have adopted it for the use of their vessels. One experiment was a week-

ing the engines of the *Prince George* steam-boat from London-bridge to Chatham, Sheerness, and Southend. The same weight of Mr. Geary's coal was taken on board that was usually consumed in a trip to Chatham of common coal, and there was found to be sufficient to work the engines as far as Gravesend on the return voyage. Another trial was in the *Duchess of Kent* steamer. The quantity of common coal usually burnt by this vessel in a voyage to Ramsgate is *five tons*; she performed the voyage with *three tons and a half* of Mr. Geary's Patent Coal. The price paid for the common coal by the Commercial Company was twenty-three shillings per ton. The cost of the patent coal is eighteen shillings per ton. From this there appears an enormous saving in cost, in stowage room and in weight.

There are other advantages besides these which it is important to mention: the captains and engineers of the boats state that there are hardly any ashes left after combustion; no clinkers; only a light white vapoury smoke; and that the labour of stoking is much reduced.

We also understand that coke manufactured from the article has been used with great success on some of the railways, particularly the Eastern Counties.

An extensive manufactory has been erected for the production of this patent fuel, in the neighbourhood of Bow, and another is in preparation at Gravesend. Judging from the foregoing statements, we may venture to predict an extensive demand for this new article of commerce. Idem.

Reproduction of Books and Engravings.

One of the most important discoveries is the one applicable to the reprinting of books, or reproduction of engravings. M. Dupont, a very industrious printer, was seeking the means of saving the expense of stereotyping. "With the assistance of a peculiar kind of ink, he was enabled to render the preservation of the stereotype plates unnecessary, and thus to save the large stock of materials, the space occupied by them, and the expenditure of much money; all which is effected by the mere preservation of a printed sheet which lithography would reproduce whenever it was wanted," but doubting whether the ink used upon that sheet would retain in the course of time the same properties, he consulted his brother, a very intelligent lithographer, and the latter found what neither ventured to expect. This new process is applicable not only to fresh printed sheets, but likewise to the oldest engravings, to the oldest books, and, what is of far more interest, to Greek, Chinese, and Hebrew books. It consists in two operations. Over the page or engravings of which you want a copy, you lay a particular composition. It is placed upon the lithographic stone and pressed, and the stone reproduces, with scrupulous precision, the original engraving or book. This impression could not, however, serve such as it is. It is itself covered with the same preparation, and it may then print thousands of copies, by the ordinary process of every sort of lithography. Five minutes suffice for both operations. The original engraving may be restored to the portfolio which has supplied it, for it has not been injured; the book, thus wholly reprinted may undergo another binding, and then honourably resume its place in your library. This new process admits of a reduction of seventy-five per cent upon the expense of printing; and as for engraving, that which on copper would cost one hundred francs, will now cost but twenty francs! What consequence will not this discovery yield? It threatens the graphic arts, engraving and printing, with a complete revolution. A man of the greatest

melted in a pot, and the cinders gradually introduced—stirring constantly. The powdered clay is next to be added gradually, then one-half of the small coal; as soon as these matters are well amalgamated—being kept at a good heat during the operation—the acid is to be poured in, and well stirred through. An effervescence will in a short time take place, producing a froth on the surface of the mixture; and as soon as this appears, add the remainder of the small coal. The mixing of the ingredients having been completed, the fluid mass must be kept in a state of agitation by stirring until the whole is well and equally heated. The mixture may then be run into moulds of any desired shape. When the mixture has become partially cool, pressure or beating may be applied in order to compress the blocks of fuel into as small a compass as possible. The pressure or beating is not essential, except in cases where the coal is intended to be used as steam-boat fuel, where stowage room is valuable.

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talent in the art lays claim to priority in this discovery, as is always the case—when success has been obtained, claimants come in. The wisdom of the central jury and patent laws must decide the question. In the meantime MM. Duponts are manufacturing, which is always a great point. On Monday, the King, Queen, Madame Adelaide, and Princess Clementine again visited the exposition, and examined the lythotypographic produce of the brothers. His Majesty observing an engraved head of Albert Durer, of 1527, which was wanting in his collection of the Palais Royale, ordered a copy of it, and congratulated M.M. Duponts upon a discovery whereby there would be no longer any scarce engravings or books.

Paris Periodical for June.

Electricity.

M. Becquerel has read the first part of a memoir before the French Academy of Sciences, containing an account of his new experiments on the electric effects of contact. These lead him to conclusions concerning the causes of certain effects which differ from those of Davy, who ascribed them to mere contact. M. Becquerel refers them to friction, and hopes to prove it by the following experiments. First, two condensing plates, made of platina, were adapted to an excellent electroscope; one of them was touched with a heavy dry piece of chalk, and the other with the finger: on separating the plates, it was found, that no electric effect had been produced. Secondly, a layer of calcined lime, highly dried, was spread on a piece of wood, equally dry; upon this was carefully placed, so as not to allow of friction, a plate of copper, fixed to a handle: it was then put in contact with one of the plates of the condensator, while the other was touched with the finger. After repeating this several times, no electric discharge was obtained, but if the copper disc were placed on the lime with friction, the condensator was charged after touching a few times, and the greater the friction the stronger the charge. The lime assumed positive, and the metal negative electricity. Thirdly, if oxalic, succinic, benzoic, or boracic acid, was substituted for the lime, in the form of a very dry powder, electricity was also obtained by friction, but not by mere contact; and in this case, the metal took the positive, and the acid the negative electricity. Lastly, the same result was obtained from crystals of oxalic acid and lime. Therefore, says M. Becquerel, the results obtained by Davy are due to friction, and not to the electro-motive action of Volta.

Lond. Athenæum.

State and Prospects of the Iron Trade.

We learn from a very elaborate paper read by Mr. J. Johnson, before the Liverpool Polytechnic Society, that there are at this time in Scotland fifty furnaces in blast, five out, seven building, and twenty-six contemplated. In South Wales, 122 furnaces in blast, seven out, thirty-one building, and ninety-one contemplated. In 1740, the annual produce of the kingdom was 17,350 tons of cast iron. Mr. Johnson thinks it probable, from the above data, that in 1842, Scotland alone will produce upwards of 360,000 tons, and that within five years 1,000,000 tons will be produced annually in South Wales.

Ibid.

Progress of Physical Science.

"*Magnetical Investigations.*" *By the* Rev. Wm. Scoresby, B. D., *Fellow of the Royal Societies of London and Edinburgh; Corresponding Member of the Institute of France, &c. &c.*

We have, in this work, a series of magnetical observations and facts of exceedingly great interest, whether they be viewed in a theoretical point of view, or as of practical applicability. The labours of Mr. Scoresby, as an experimental philosopher, have long been sufficiently known to the scientific world to establish his reputation as an indefatigable and exact investigator; and we have great pleasure in stating that the originality of many facts which we have observed in this neat little volume, do equal credit to the author with any of the preceding results of his valuable investigations.

Mr. Scoresby prefaces his interesting Investigations with the following series of "Introductory Observations," so admirably appropriated to the scientific importance, and theological dignity, of his subject.

"It has long been conjectured that a most intimate connexion, if not an identity of nature, might probably exist among some of the more subtle and mysterious agents, or principles, of different denominations, and, apparently, of different characteristics, which universally pervade the region in and about this earth.

"Modern discoveries in electro-magnetism, with the cognate relations which these have developed as existing in other principles of natural bodies, have gone far to verify these anticipations; and at the same time to yield so much additional knowledge of the constitution of the physical system of our planet, as to give a new, an interesting, and a prominent, importance to electrical and magnetical science.

"To the time of Dr. Gilbert, of Colchester, magnetism was only known as a mysterious virtue, existing in, and peculiar to, the loadstone, or ferruginous substances which had been touched by this extraordinary mineral, from which certain qualities of attraction and direction were derived. But this eminent individual discovered, as he has left on record in his 'Physiologia Nova, seu Tractatus de Magnete et Corporibus Magnetisis;' published in the year 1600, that the phenomenon of the meridional adjustment of the magnetic needle was not owing to any mystical virtue, exercised out of the course of natural principles, but a mere result of the directive action of the earth; which he truly considered as the controlling agent, by reason of its being in its matter and constitution, magnetic.

"So long as magnetism was known only as a separate or simple principle, the philosophic ideas of Dr. Gilbert were never materially advanced; but, on the discoveries of Professor Œrsted, whereby the long-suspected connexion betwixt electricity and magnetism was established, an amazing enlargement was at once yielded to magnetical knowledge, and a corresponding impulse given to magnetic research.

"The effect has been to give a science, formerly considered as comparatively of an inferior class, a grandeur of consideration; placing it at once amongst those mighty principles which infinite wisdom has appointed, and infinite power ordained, as essential elements or agencies in the physical constitution of the world. For inasmuch as the inseparable connexion

has been established betwixt electricity and magnetism, these, under various forms of development, reciprocally developing each other, it necessarily follows, that, to whatever extent in creation electricity operates, to the same extent the magnetic principle must reach. And inasmuch as heat, light, and chemical action, are each, more or less, developers of one form or another of the electro-magnetic principle, the analogies of science would lead us to infer, that magnetism is co-extensive with these other agencies, throughout their range of operation. Hence, there is little doubt but the principle, which, a few years ago, was known only as a director of the compass needle, as to its utility, and as little more than a curiosity in science, is one of the mighty energies by which, instrumentally, the works of the great Creator are regulated; one of those subtle powers, which he hath ordained as his servants, 'fulfilling his word;' and whereby, 'the sweet influences' of the whole system of the universe are bound together, controlled and upheld. Thus the subject of magnetism becomes of the highest consideration; in science, as to its mightiness and extent of operation; and, in natural theology, as calculated to connect the researches of human intelligence, with Him who hath created these wonders; to elevate the feelings of reverence and adoration in the devotional mind, and to proclaim more clearly, in proportion as the invisible things are understood, 'His eternal power and Godhead.'

"It is not my object, however, in this publication, to carry out those views to which the more enlarged consideration of magnetism, as a science, might be advantageously applied; but that, in thus showing something of the importance of the subject as a science, I may solicit, for the contributions which are here offered for it, such reasonable consideration as, in this connexion, they may fairly claim.

"To the subject of *magnetism*, my attention has, for a series of years, been more or less directed; latterly with the view, particularly, of producing more powerful instruments for the determination of delicate variations in, and the actual condition of, the earth's magnetism; a subject which, from its greatly increased importance, is now engaging attention in some of the principal observatories in Europe.

"In contemplating such improvement in instruments dependent for their adjustment on the earth's magnetism, the grand desideratum would obviously be, the attainment of increased energy, or directive power, in magnetic needles, or bars of any given length or mass. And, that the attainment of such increased energy was a promising field of enquiry, I was satisfied, from the mere consideration of the surprising superiority in power of electro-magnets over permanent artificial magnets; strongly indicating the existence of a far greater capacity for magnetism, than we have hitherto been able to develop, or, if developed, to retain. Whilst this consideration yielded every encouragement to the enquiry, an experimental fact, in regard to the proportional power of magnets of *unequal thickness*, suggested that guidance, in pursuing the enquiry, which not only led (as will, I trust, subsequently appear) to a successful result in regard to the object particularly specified, but gave rise to investigations extending beyond my original design, and eminently calculated, I conceive, for the improvement of sea compasses—hitherto so very defective—as well as artificial magnets, and magnetic apparatus generally. The fact referred to was this. When examining, many years ago, the directive power of various artificial bar-magnets, for the purpose of determining the practicability of ascertaining the thickness of rocks, &c. in tunneling and mining, by the method of de-

viations communicated to the Royal Society in 1831,—the idea occurred to me, that, if the bars ordinarily employed for compass needles, &c., were divided into laminæ; or if, in other words, they were made up of thin plates to the extent of the masses of the bars commonly in use, a greater degree of energy would be obtained. Experiment fully justified this opinion. But previous to the application of the principle to instruments directed by the earth's magnetism, I had made trial of a combination of laminæ of *thoroughly tempered steel*, for the construction of a small compound magnet. The substance made use of was watch-spring, of which fourteen pieces, of two inches in length, were combined, after being magnetized, and formed a small magnet, weighing, in amount of steel, about one hundred grains. From a want of knowledge, at that time, of the best mode of magnetizing thin plates, the power obtained was much less than was expected; but when the same little instrument was subsequently magnetized, in a mass, by the process hereafter described, its efficiency became very striking,—the power being found to be such as to lift, by one pole, a polished nail of about 800 grains, or eight times its own weight.

"A trial apparatus, of the nature of a *variation needle*, on the same principle,—improved, however, for this purpose, by the *separation* of the plates —was constructed in the year 1836, which was exhibited to the 'British Association for the Promotion of Science,' the same year. But being without any *precise* knowledge of the laws of combination in magnetized plates, or even of the actual power of this instrument, though obviously great, a general idea only of its relative superiority could then be obtained. Since that time I have investigated, in an elaborate series of experiments, and with a somewhat expensive variety of apparatus, the principles of the construction adopted, so as satisfactorily to prove, I conceive, the decided advantage of that construction for sea, and other, compasses, and to apply the principle to various practical purposes in magnetics.

"In the original 'variation compass' just referred to, the plates, as I have intimated, were not placed in immediate contact, but separated by thin slips of wood or card-board; for I had previously found, when combining magnets for other purposes, that a material loss of power, in the individual intensities of the bars, was, in all cases, occasioned by combination: but that, when the combination was not made in contact, an inferior deterioration took place.

"The subjects to which I was primarily guided by these preliminary considerations and results, extended to the following particulars:—The effect of the division in various directions of the mass of steel, on its magnetic capabilities,—the law of combination of magnetized steel plates in contact—the law of combination when the plates are separated by limited spaces—the effect of temper or degree of hardness, and the degree of permanency of the power in combinations of magnetized steel plates. A few of the most important results obtained from these investigations, were forwarded to the Institute of France, in February, 1838. These investigations proved sufficient to show that the idea entertained in the outset of the practicability of producing, by means of combination of magnetized steel plates, more powerful apparatus than had hitherto been in use, for experiment and observation in magnetical science, and for practical purposes in magnetics generally, was not incorrectly founded. But the most important practical applications of these principles, with the results of several new and distinct investigations, yet remain behind. The description of these,

in the first instance, is the object of the present publication: and it is hoped that the results will be found to develop some new and some improved principles of construction, applicable both to instruments designed to be directed by the earth's magnetism, and to the improvement of apparatus in which a permanent and concentrate energy are requisite; together with a useful application of some of the laws developed in these or previous investigations, to the *testing* of the quality of steel, and the determining of the degree of its hardness, purposes of the highest importance in the construction of delicate instruments used in the arts, or by professional men.

"The several results and applications of these recent personal researches, may be conveniently classed under separate heads, belonging to the development of principles, or of different practical processes, in magnetism. Some of these will, no doubt, be resolvable, in certain particulars, into principles or methods heretofore known; but, in all, it is presumed, something peculiar, as to decisiveness of the results bearing on principles, or as to convenience of adaptation, or efficacy of manipulation, or improvement in construction, in regard to the practical subjects, will be found."

From the above prefatory chapter, our readers will discover that the objects of Mr. Scoresby's investigations are of a high scientific character; and we can assure them that we have not met with so valuable a work on magnetics as that before us, since the appearance of the second edition of Mr. Barlow's "Magnetic Attractions," a work of great merit, and intrinsic importance, in this branch of physics. It is such productions as these that every scientific man delights to peruse; and every scientific journalist ought to take a pleasure in recommending to his readers. Every novel fact that becomes developed by physical enquiries gives new impulses to the pursuit, implants an additional gem in the diadem of science, enhances the lustre of the whole, and, sooner or later, yields new sources of comfort and happiness to man.

Annals Electricity.

On the Nature of Electrical Attraction.

Mr. Snow Harris lectured, May 31, at the Royal Institution, "On the nature of electrical attractions." This gentleman, as is well known, is distinguished for his experimental researches, and for his elegant skill in devising the beautiful apparatus, by means of which he has conducted them. It is principally adapted to the purpose of ascertaining in the most precise and unvarying manner, the exact quantitative measures of the electrical charge given to bodies, and the relations of the forces under varying circumstances, as expressed in weights. The first object is obtained, by having a unit measure in the form of a very small Leyden jar, the electricity of which, when fully charged, passes by a spark to a very large jar in connection with the body to be electrified, the number of sparks determining the quantity. By this arrangement, the intensity of the charge is moderate, even when a considerable number of sparks have passed. The second object is obtained by means of a very delicate balance, having in place of one of the scale pans a piece of gilded wood, to constitute the attracted body, (which can be replaced by others of various shapes and sizes, according to the nature and purpose of the experimental inquiry,) beneath which, adjustable to any distance, is the body to be electrified, composed also of gilded wood of various shapes and sizes. The weights in the scale pan, determine the degree of attractive force, under the several circumstances of distance, size, shape, in-

sulation, &c. There were modifications of this instrument, suited for special purposes, and also one on a different plan, but having the same object in view, in which an index, mounted on friction wheels, traverses a graduated arc, and has a pulley on its axis, round which is a silk thread, one end being attached to the body electrified by induction from the directly electrified body beneath, and the other end being connected to a counterpoise dipping into a glass of water. Thus the attractive force is estimated in this case by degrees instead of by weights, through the alteration of the buoyant force of the fluid exerted upon the counterpoise, as it is more or less immersed.

By means of this and other apparatus, which it would exceed our limits to describe, the lecturer performed many interesting experiments, some of a popular kind in order to illustrate a few elementary points; but the chief scientific object, was to show, in opposition to mere mathematical theories, that the law of electrical forces, varies according to circumstances; that it is as the inverse square of the distance, only, in the case of uninsulation, but when the attracted body is insulated, that it is simply as the inverse of the distance. This was shown, both by the different number of sparks required, and by the different weights required in the different cases, to produce an equilibrium between the forces of gravity and electricity. Hence the mathematical postulate that electrical forces, like that of gravity, radiate from a centre, is an unfounded assumption, resting on an analogy which the physical character of the phenomena does not countenance; for if such were the case, those forces would, by a kind of inherent necessity, follow the ratio of the surfaces related to that centre, and consequently act with an intensity proportioned to the inverse square of the distance. But the law as experimentally developed, being in a certain case simply as the inverse of the distance, the inference is, that electrical influence acts in parallel lines. This view is borne out by experiment, for if to the surface of the electrified body, is opposed a smaller surface in the attracted body, (of course both bodies are mutually attracted, but we use the term as distinctive of the one which is put in motion) the force of attraction will augment with every increase in the smaller surface until it attains its maximum, which will be, when the two surfaces become equal, beyond which it will not be added to or diminished, by any enlargement whatever of the non-electrified surface. This conclusion from the experiment is perceived with greater force, when it is considered that the attracted body is attached solely in virtue of an opposite state of electricity residing over the whole of its under surface, induced in it by the directly electrified body. The inference is further confirmed by other experiments, touching the relation between spherical and plane surfaces; thus, to select one instance, the attractive force of two opposite spheres, is precisely the same as the influence of the two nearest hemispheres.

It is the peculiar reflex action of the induced electricity in the attracted and insulated body, which, augmenting the totality of the force, produced also, as we understood the lecturer, that modification of the law as before stated, which obtains in this particular case. It was also shown, that the augmentation of the electrical force by induction, is in the ratio of the square of the quantity, or, the quantity being the same, that the force is doubled. The illustration of the latter fact by experiment, was exhibited by means of the second instrument before described. In connection with the electrified body, was a large circular disk, the communication with the machine being through the latter, underneath which, was a second insulated disk of the same size; this being withdrawn, the index showed a diminution of

attractive force by one half. Mr. Harris also gave a few experiments which led him to believe in the materiality of electrical influence, and that it does not consist in molecular vibratory motion—one of which was, the uninterrupted energy of its propagation, which is exhibited in a conductor bent to a right angle. He also adverted to the fact, so contrary to received opinion, that he had been able to retain a charge on an electrified body in a vacuum for a considerable length of time.

Remarks.—We are sorry that we have been able to give only the above rather imperfect notice of this interesting lecture, so far at least as regards the precise details of the experiments, owing in a great measure to the lecturer having turned his back upon a part of the audience whilst performing them, (the instruments having been placed on the front of the table) so that situated as we were, neither seeing nor hearing fell to our lot. A reiteration of statements by the lecturer is also very desirable in certain cases. We hope, however, that we have not materially misunderstood him on any point, though we confess we do not perceive, how the *law* of electrical force is affected by any variation in the reflex action of induced electricity, the tendency of which would seem to operate only on its intensity. So great a change in the law, points to its being of a secondary kind, resulting from different mechanical actions, dependent on essential differences in the physical circumstances of each case. The researches of Mr. Harris well deserve the attention of mathematical theorists, the discrepancies which he has brought to light, are not to be slighted and passed over as being merely apparent anomalies arising from the complication of the mutual actions, and which theory could elucidate, even to the bringing out of the same results, if pursued into, and made to embrace, all the minutiæ of the case. Mr. Harris does not belong to this self-sufficient *a priori* school, the old Aristotelian spirit of which is ill concealed by its mathematical guise, but he is a philosopher of the right stamp—cast in the true Baconian mould—one who being distrustful of the power of mere intellect to deal with the secrets of nature, is inclined to pay a greater deference to her teachings than to those of man; and who would sooner suspect the conclusions of theory, than even the slighter inferences from experimental investigations, and much less, those more legitimate inductions, which depend on, and are guaranteed by, varied attesting confirmations. Lond. Mech. Mag.

On the Polarization of Light by Living Animals. J. F. Goddard, *Lecturer on Optics, &c., at the Royal Gallery of Practical Science.*

On repeating the experiments published in 1816, and others subsequently noticed by Sir D. Brewster, on the polarizing property in the eyes of fishes and other animal substances, with my Polariscope, after observing that the *scarf skin* of the *human subject*, sections of *human teeth*, the *finger nails*, *bones of fishes*, &c., possessed the same property, I was led to examine some living objects, when I discovered that, among many others, the larvæ and pupa of a tipulidan gnat (the *Corethra plumicornis*) possessed this property also, and that in a very eminent degree. Its existence in the different substances above enumerated is exceedingly interesting and important; but that it should also exist in living animals is infinitely more so, and opens a new field altogether, disclosing characters that lead to an intimate knowledge of their anatomy, and which cannot possibly be discovered by any other means.

This creature is found in large clear ponds, generally in great abundance

when met with, but this is by no means common. Having constructed a water trough, made with two slips of glass about 1.25 inch wide and two inches long, with very narrow slips of thin glass cemented with Canada balsam between them, at the bottom and sides, thus leaving it open at one end, with about the 0.050 of an inch space between in the middle, I filled it with clear water in which I placed some of the larvæ; and such is the extraordinary transparency of the creature, as to display in a most beautiful manner the whole of their internal structure and organization, and which, when viewed in polarized light, presents the most splendid appearances. Thus when they place themselves with their head and tail both in the plane of primitive polarization, or in a plane at right angles to it, they have no action upon the light transmitted through them; but when in a plane inclined 45° to the plane of polarization, the light is depolarized, their whole bodies becoming illuminated in the most brilliant manner, varying in intensity according to their size, and the nature of the different parts and substances; the peculiar interlacing of the muscles marking out regular divisions, which, as the creature changes its position with regard to the plane of polarization, exhibit all the varied hues and brilliant tints that have rendered this important branch of physical optics so exceedingly interesting.

And while thus viewing them, if we place behind, a thin plate of sulphate of lime or mica, the change and play of colours as the creature moves are greatly increased, and exceedingly beautiful.

These phænomena in the larvæ of the *Corethra plumicornis* are seen if possible in a more splendid manner in the spawn of many large fishes, but more particularly in the young fishes themselves, which in their early state are, many of them, equally transparent, particularly those of marine production.

The first time I showed them was on the 7th June to Mr. F. Watkins, afterwards to T. E. Wilks, Esq., and other gentlemen; and on Tuesday evening the 25th June, I read some notes on the subject, and exhibited them with many other experiments, to the members of the Zoological Society, at one of their regular meetings. Philos. Mag.

Remains of the] Mammoth dredged up in the English Channel and German Ocean.

The fishermen employed off the east coast of England are frequently impeded in their operations by large boulders and bones of mammalia becoming entangled in their tackle, and in order to clear their fishing grounds of such obstructions, they bring the masses on shore. The animal remains noticed in this paper are chiefly in the possession of the author, and consist of tusks, teeth, and bones of the mastadon. They were obtained between Dungeness and Boulogne, Dover and Calais, and Yarmouth and the coast of Holland; and Capt. Martin states, that they were wholly procured in hollows or submarine valleys. The boulders are also accumulated in depressions, and consist of a great variety of rocks. Some of them are much worn or rounded, but in no instance do they present those regularly-shaped forms which would lead to the inference that they might have composed part of shipwrecked cargoes.

To this communication was appended a note by Sir John Trevelyan, on a molar of an elephant found thirty-eight years ago in the bed of the Severn, near Watchett. The same gentleman has also informed Dr. Buckland that Roman pottery has been frequently procured during the last fifty years from the bottom of the estuary of the Thames, near Margate; and

that Pott Island, off Herne Bay, has received its name from the quantity of similar remains obtained near it. A Roman vessel, laden with pottery, is supposed to have been wrecked at this spot. Mining Review.

Five Fossil Trees found in the excavations for the Manchester and Bolton Railway.

One of these trees was discovered in 1837, and the other four during the present year, in forming a drain. They are situated in a nearly straight line, in beds of shale belonging to the great Lancashire coal field; and the distance between the first and the fifth is about 105 feet. The roots, as far as they have been exposed, are spreading, and they are apparently quite conformable in position to the inclination of the stratum in which they are imbedded. The stems are nearly at right angles to the plane of stratification, and were enveloped, when discovered, in a thin coating of friable coal. The internal argillaceous casts are fluted, and Mr. Hawkshaw states that there are indications of a fibrous structure. The largest tree is eleven feet high, fifteen feet in circumference at the base, and seven and a half at the top. The others vary in height from six to two and a half feet, and in circumference at the thickest part from nine to six feet; but the girt is not always proportioned to the height. The roots of one of the largest specimens extended between five and six feet from the trunk. A thin stratum of coal was cut through on the same plane as that of the roots, and on excavating on the opposite side of the rail road, the seam was also found at the distance of about ten yards. In the immediate neighbourhood of the roots the shale contained so great a number of *Lepidostrobus variabilis* that more than a bushel of specimens was collected.

Of the generic characters of the trees, Mr. Hawkshaw offers no opinion, as the coal which occupied the place of the bark was too friable to permit the external markings to be determined; he, however, alludes to the opinion of M. Adolphe Brongniart, that the *Lepidostrobus variabilis* was the organ of fructification of a species of Lepidodendron.

Mr. Hawkshaw has not only prevented the trees being removed from the position in which they were discovered, but he has had them protected from the weather; and he invites geologists to examine the interesting phenomena which they present. Ibid.

Coal-fields of Nova Scotia and Cape Breton.

The mineral products of Nova Scotia are extensive and valuable, forming already a large proportion of its exports, and promising to rise rapidly in importance. Coal, the most useful of any, particularly abounds, and has its value greatly enhanced by the great demand for it over the whole of the American continent. The chief bed, on the northern coast near Pictou, is estimated to comprehend an area of about 100 square miles; but this space is intersected by large dykes and interrupted by faults, so that the actual extent is not yet ascertained. There is some reason to think that it may stretch considerably farther, though sunk too deep to have yet been traced. It has a glossy, jet black appearance, is highly charged with bitumen, melts and cakes like that of Newcastle, and, when the tar is dissipated, burns like coke. It is extremely well adapted for manufactures, especially in iron. Farther east, near Pomket and Dorchester, copious indications of this mineral have been discovered, but not yet examined. In

Cumberland also, pretty large veins have been traced, though the quality is not uniformly good. Cape Breton is equally distinguished for its stores of this precious mineral. The Sydney coal-field, extending along the coast from the capital to Miray Bay, and thence inland to the great entrance of the Bras d'Or, is estimated to contain 120 square miles of workable coal. It is generally of excellent quality, and in great part adapted for domestic use as well as for manufactures. In the western district of this island, too, there appears to be a considerable bed, though not yet scientifically explored.—*Edinburgh Cabinet Library, No. XXVI. Historical and Descriptive Account of British America, vol. II.* Ibid.

Progress of Civil Engineering.

The Great Western, Cheltenham and Great Western, and Bristol and Exeter Railways.

"The Great Western Railway has always occupied a great share of public attention, equally from its position, as from the peculiar features which distinguish its construction. It forms a direct communication through Bath between London and Bristol, and is one of the most important lines of traffic in the kingdom. Passing through the middle of the south of England, it commands the traffic of above two millions of people and of the richest part of the island with the rest of the country. The vale of the Severn, with a large population, is also one of its general tributaries; and altogether it occupies a position perhaps unequalled in railway communication. Branches are already in progress, giving it, by Cheltenham and Gloucester, a second communication to the north, and by the Exeter line a certain monopoly of the south-west of England. Of the road to the south of Ireland it can never be deprived; and recently it has entered successfully into competition for a portion of the American traffic.

"It is 117½ miles long, and proceeds through the basin of the Thames as far as Swindon, soon after which it enters that of the Avon, which it pursues for the remainder of its course. It commences in some of the earliest formations of the tertiary period of the London basin, in which it continues nearly as far as Reading: it then passes through the chalk for some distance, and ends in the secondary formations, which are compressed as it were together a short distance from its terminus. It affords as great a variety of geological sections as can be obtained on any line, and is one of the best tours that can be pursued by the geological amateur. Following the banks of the Thames, it visits scenes richer in their historical and literary associations than any part of the empire; and affords never-failing enjoyment to the admirer of the placid beauties of English landscape. On the right it has the renowned spa of Cheltenham and the unrivalled scenery of the Wye; and after passing through Bath it has on the left countries as rich as they are picturesque. Thus it vies with any railway in the world for the beauty of its position; and it is of itself an interesting feature, from the grandeur and novelty of its construction.

"After the usual surveys, and the accustomed time spent in obtaining capital, this great undertaking received the royal assent to its Act of Incorporation on the 31st of August, 1835, and active operations were immedi-

ately commenced to ensure its energetic prosecution. It is one of the most simple lines in its section of any railway in the kingdom, and is formed of two principal inclined planes. It was the object of Mr. I. K. Brunel, its projector and engineer, to make the plan as perfect in its details as the present state of science would permit, and, so far as practicable, to anticipate the future progress of railway improvement. One of his endeavours was to obtain a line as nearly level as the nature of the ground would permit; and he has so far succeeded, that, according to the testimony of the most eminent engineers, it is unequalled for its gradients. There is only one summit level, which is at Swindon, near the Cheltenham branch; and here it is 253 feet above the London depot, and 275 feet above that at Bristol—76 miles distant from the London end, and 41¼ from the other terminus. From London to Dudcot it rises gradually at a rate not exceeding four feet per mile, or one in 1320, and generally under that. Thence to Swindon it continues to rise with a maximum inclination of 6 feet per mile, or 1 in 880. From Swindon to Bath the general gradient is 6 feet per mile, or 1 in 880; but it is broken by two inclined planes, both of 1 in 106 or 50 feet per mile—that at Wootton Basset 1 mile 3 furlongs in length, and that at Box of 2½ miles. The curves are chiefly of 4, 5, or 6 miles radius, and are as gentle as possible; one curve, however, is not more than three-quarters of a mile radius.

"For 96 miles from London there is no tunnel, until we come to that at Box, which is the longest on the line, being 1¾ miles in length; but between Bath and Bristol are four, one of 528 yards (1-3d mile,) one of 1012 yards (⅝ mile,) one of 132 yards, and another of 435 yards (¼ mile.) The tunnels, although for a longer line, are three-quarters of a mile less than on the London and Birmingham Railway. The width of the tunnels is 30 feet, and their height varies from 25 to 30.

"The cuttings are about ten millions of cubic yards, and, according to the Parliamentary evidence, are lighter than on any other principal line; the proportion being, for the Southampton, about 200,000 yards per mile; for the London and Birmingham, 110,000; for the Liverpool and Manchester, 100,000; and for the Great Western, 80,000. The average of the deep cutting is from thirty to forty feet, and of the embankments from twenty-five to thirty feet, and they rarely exceed these heights.

"The construction of the Great Western Railway differs from that previously adopted, and these variations may be arranged under several heads. The width of gauge or distance between the rails generally used is four feet eight inches and a half, but experience has shown, on the Liverpool and Manchester Railway, that the rails are too narrow for the boiler-room they want. On the Czarsko Selo Railway six feet has been allowed, and in Ireland a wide gauge has been preferred. The width determined upon by Mr. Brunel is seven feet, and the reasons in favour of it are, that it will allow of a higher rate of speed. The diameter of the wheels of the carriage has also been increased, while the centre of gravity of the carriage is kept low; and thus less friction and greater steadiness of motion are obtained. All sorts of carriages can be carried within the wheels of the trucks, and larger and more powerful engines may be employed. Mr. Brunel has also in some places substituted for blocks a continuous bearing of timber, with piles, upon which the iron rails that constitute the track of the wheels are placed. Longitudinal timbers of Memel pine, Kyanised, of a scantling of from five to seven inches in depth, and twelve to fourteen inches in breadth, and about thirty feet long, are placed along the whole line. Then

these timbers are bolted to cross sleepers or transoms at intervals of every fifteen feet; double transoms, each six inches broad, and nine inches deep, being placed at the joinings of each of the longitudinal timbers, and single transoms of the same scantling being placed midway between the joinings. These transoms stretch across, and are bolted to all the four lines of rails. Within the two lines of rails of each track, piles of beach, Kyanised, are driven from the upper surface of the railway into the solid ground, so as to retain a firm hold thereof, and the transoms are bolted to the heads of these piles. These piles are so arranged that the piles of the corresponding rail are placed opposite to the intermediate distances, and not opposite to each other. To prevent the sleepers from spreading, there are, at every fifteen feet, iron ties across the railway, spiked down at each end to the sleepers.

"The Bristol and Exeter Railway branches off from the Great Western, near Bristol, and runs parallel to the estuary of the Severn, as far as Bridgewater, when it follows the course of the rivers Parret and Tone, and of the Bridgewater Canal as far as Taunton. It then runs by the side of the Western Canal, and afterwards enters the valley of the Culm, which it pursues until its junction with the Exe at Exeter. It is on the same grand scale as the Great Western, and under the direction of the engineer Brunel, who has distinguished himself so much by his exertions to secure their good construction. The length of this railway is seventy-six miles; and although the country through which it passes is difficult, yet it presents comparatively but little cutting, embankment, or expensive work. The capital of the company is 1,500,000*l.*, and the amount to be raised by loans 500,000*l.*"

Min Rev.

Influence of Railways.

The history of the great railway between London and Birmingham is now finished. A wonderful work it is to look upon, whether it be contemplated in its magnitude and difficulties, its science and capital, or its utility and results. It stands as much the monument of this age as any of the great works of antiquity that have been the subjects of the world's history. There is, however, this difference in its favour, that while they have been raised in the cruel exercise of despotic power, and have mainly subserved the purpose of personal vanity, this has been accomplished by the profitable employment of the redundant capital of a single district, to meet the wants of a vastly improved people, and is the triumphant invention of science, trained and disciplined under severe study, and gathering accelerated strength from the successful experiments of each succeeding year. The flexible power of steam was, indeed, known to the philosophers of former times; but they used this knowledge only for the fantastic purposes of caprice and amusement. Anthemius, in the age of Justinian, employed his acquaintance with this principle to annoy a troublesome neighbour, and by imitating an earthquake frightened Zeno out of his house; and, at an after period, Pope Silvester invented an organ, which was set in motion and worked by it. It is the glory of the present era, that science and utility go hand in hand to advance the improvement and happiness of the nation.

Every age of the world has furnished its own peculiar inventions, and these have generally been well adapted to the wants that suggested them, and to the condition in which society was at that time placed. It is a sub-

ject more than commonly interesting to contemplate genius toiling amidst so many difficulties, and by patient perseverance overcoming all perplexity and opposition. It is, perhaps, still more interesting to observe it under the trials of its first experiments, amidst the doubts, unbelief, and sometimes jeers, of the multitude, self-possessed in the truth of its principle, yet tremulously fearful while lying at the mercy of the thousand contingencies that might thwart or destroy its hopes and expectations. Such was the case with Telford, on the final erection of the famous hanging bridge over the Menia Straits. It is said that his heart sunk as every successive bolt was struck, till overcome with the agony of his feelings, he retired to his cottage hard by, and awaited on his knees the result. The shouts of the admiring populace, when the wonderful fabric settled into its place across the turbulent waters, and his own almost inarticulate thanksgiving in his secret chamber, arose together in the triumph of that hour.

When poor Henry Bell, after years of thought, labour, and experiment, first pushed his steam vessel on the Clyde, it was done amidst the scoffs and evil surmises of those who assembled to witness the scene. The inventor died in poverty; but an obelisk that rears itself on the banks of that fine river, near Dunglass, attests the tardy, and to him almost useless, gratitude of his countymen. Fulton embarked on the Hudson with the same contemptuous greetings and prognostications, from the very people who assembled in thousands to hail the arrival of the Great Western and Sirius steamers, across the vast Atlantic, to their own shores. He lived to see, and in some degree to share, the complete success of his genius and mechanical skill.* How deeply we are indebted to these children of science who carried forward their discoveries,—in the benefits of which we so largely participate,—almost broken-hearted, amidst the chilling indifference or the withering contempt of a selfish world!

The work of which we have been treating has involved nearly, if not altogether, a capital of six millions of money in its completion. This enormous amount will require three hundred thousand pound per annum, merely to pay its interest, at five per cent., besides a very considerable sum in addition, to defray the wear and tear, and other expenses of its yearly operations; and yet with all this immense outlay, it is certain, from the host of travelers it will allure into a state of locomotion from pleasure or profit, and the various lines that will eventually flow into it, that it will be one of the most productive railways in the kingdom. We cannot, indeed, clearly foresee the end of such an invention, of which this is one of the greatest experiments, or the condition of society it may ultimately produce; but we are warranted in believing that this onward state of improvement, by facilitating and enlarging the sphere of social communication, will tend greatly to increase the amount of social happiness; and in its combining and assimilating influences over the great human family, will assist in bringing about the benevolent purposes of Him, "who hath made of one blood all nations of men for to dwell on all the face of the earth." C. E. & Arch. Jour.

Cornish High-pressure, Expansive, Condensing Steam Engine at Carlisle.

On Saturday last, the 25th ult., the engine manufactured in Cornwall by Messrs. Harvey & Co., of Hayle, from the specifications and plans of that

* The engine used by Fulton, in his first steam boat on the Hudson river, was made by Messrs. Boulton & Watt, of Soho.

eminent Cornish engineer, William West, for the Carlisle Canal Company, commenced working. The directors having assembled at twelve, in a few minutes after, the engine was started by Mr. Halson, the chairman, and Mr. West, who had arrived from Cornwall for that purpose. The volume of water sent forth excited universal surprise amongst the numerous gentlemen and artizans whom curiosity had drawn to the spot, and was gratifying in the highest degree to the directors and proprietors of the company.

The engine (named the "Eden") is set up for the purpose of supplying the Carlisle Canal with water from the river Eden. The height the water has to be lifted is about fifty-six feet; the steam cylinder is sixty inches diameter; that of the pump forty-five (the largest of the kind in the kingdom;) length of stroke ten feet. In less than two minutes, the huzzas of those assembled announced that water had been lifted to the pump-head, whence it was poured fourth in a solid, continuous, and rapid steam, at the rate of 6624 gallons per minute; consequently, working at twelve strokes, the quantity delivered in twelve hours into the canal is 4,769,280 imperial gallons of water—equal to 765,288 cubic feet—at an expense of fuel under 5*s*.

The canal from Carlisle to the Solway Frith is about twelve miles in length. There are six locks, each about sixty-seven feet long, twenty-two feet wide, and eight feet six inches deep; and when required, such is the power of this simple, yet effective machine, that the quantity of water contained in each lock can be replaced in less than ten minutes—*i. e.*, as quick nearly as a vessel can be passed through. In the course of a month, when Harvey and West's new patent valves shall be subsituted for those now in use, the work will be done better, and with considerably less friction; and the heavy blow, and consequent vibration common to all pumping-engines will (it is said) be entirely overcome.

Mr. West's engine, at the Fowey Consols Mine, in Cornwall, on a trial, lifted 125,000,000 lbs. weight, one foot high, with 94 lbs. of coal, and averaged upwards of 90,000,000 during twelve consecutive months. At the Portsmouth and Farlington Water Works, the consumption of coal has been reduced (and doing more work) full 75 per cent., and a further saving will yet be effected, by the introduction of the patent valves. At the office of this company, 15, St. Mary Axe, London, full particulars will be given to any gentlemen of the north interested in coal mines or steam power. Mr. Wicksteed, the highly talented engineer of the East London Water Works, computes their saving at 70 per cent., viz., 1297*l.* 16*s.*, instead of 4328*l.* 2*s.* The engine at the East London Water Works has a cylinder of eighty inches, is now at work night and day, and has turned idle three engines of large dimensions erected by Bolton and Watt; further saving will likewise be effected there as soon as the new patent valves are in operation. These valves cannot fail to rank amongst the most useful and important introductions of the present day, and for deep mines or exceedingly heavy columns must come into general use. Neither of the engines before noticed, nor any engine we have ever heard of in the north, is equal in size to that lately sent to some extensive coal works near Namur, in Belgium; the cylinder of which is ninety inches diameter, stroke eleven feet, manufactured likewise by Harvey & Co., of Hayle Foundery; but as to "duty," the Cornish engines are so pre-eminent, that comparison must not be instituted. Some of the engines in the north, lately erected, are amongst the worst to be seen at the present day in Europe. Min. Jour.

The Bude Light in the House of Commons.

The experiments of the Bude lights for lighting the House of Commons were lately tried, chiefly with the view of ascertaining the effect of the new plan upon the reporters' gallery. As far as that part of the house was concerned, we can say the trial was altogether successful. Though the apparatus for conveying the light to that, as well as to other parts of the house is not yet complete, yet enough of its operation was seen to show, that when complete, its superiority over the wax lights will be past all question. We understand that on the first trial, the complaint was general that the glare thrown into the body of the house was greatly offensive to the eye, while the seats under the gallery were in comparative obscurity; the grounds of this objection have now been wholly removed. The light is now made to descend from the roof through ground glass plates, over which the apparatus is so contrived that the light can with ease be varied from the colour of a pale moonlight to a bright sunlight, or be mellowed down to a rich autumnal glow; still giving sufficient light, without any unpleasant glare, to every part of the house. The glass through which the light is sent down is fitted air-tight into the bottom of the chandelier, so that no heat can be generated by it in the house, save the slight radiation from the surface of the chandelier itself; but compared with the heat and the consumption of atmospheric air, by the combustion (or rather the very imperfect combustion) of 240 wax candles, the heat and atmospheric combustion of the new plan are not (as far as the body of the house is concerned) as 1 to 100. Whatever heat may be generated by the new process will be carried off through the roof, and never affect the body of the house. To those of our readers who may not be acquainted with the nature of what is called the "Bude" light, it will suffice to say, that in Mr. Gurney's plan it consists in a number of burners (in each chandelier) supplied with wick and oil, somewhat like the Argand lamp, with the improvement that in this there is only one circle or cylinder, while in the common Argand lamp there are two. Lighted in this state, the lamp would send off a very large and offensive mass of unconsumed carbon; but to prevent this, a stream of oxygen gas is made to pass through the centre of each burner, by which the total combustion of the carbon of the oil and wick takes place, and the light is consequently raised to a beautifully brilliant flame, the intensity of which may be increased according to the volume of the stream of oxygen passed through it, and, as we have already said, the light may be mellowed as taste, fancy, or convenience may suggest. From what we saw last night we think the very clever plan of Mr. Gurney a vast improvement on the present system, and, as Joe Hume would say, "it is a great deal cheaper."*—*Times.* Mech. Mag.

Opening of the Eastern Counties' Railway.

A large concourse of persons assembled on June 18th at the temporary station, Devonshire-street, Mile-end, to witness the departure of the first train on this line of railroad. Shortly after one o'clock the train started amidst the firing of guns and general acclamations of all present. The line commences at Shoreditch, on a viaduct about twenty-one feet above the level of the ground, up to which extensive and commodious carriage ap-

* We should be glad to see some account of the manner in which the oxygen gas is supplied,—the material used in its production, size of the gasometer, &c. G.

proaches will be made. At the commencement of the viaduct it is proposed to erect the London station, which will be of commensurate extent with the existing traffic. In it are several bridges, the arches of which are faced with stone, which gives them a handsome and imposing character, especially the bridge over Devonshire-street, the arch of which rises less, for the span, than we have observed on any other line of railway, the rise being less than one-tenth of the span. The line then passes over the Regent's Canal by an iron bridge, the general appearance of which has been much admired; two main ribs of iron, of fifty-four feet span, partly on the bow suspension principle, are thrown over the canal, to which transverse girders are fixed, supporting the roadway, on which are laid longitudinal sleepers of timber receiving the rail. An ornamental railing gives a finish to the whole. Passing successively over the River Lea, Grove Road, Coborn Road, Fairfield Place, and Old Fort Lane bridges, besides numerous other smaller archways, the railway passes over the Stratford marshes, within a few feet of one of the extensive reservoirs of the East London Waterworks. On this part of the line there are numerous bridges over the various streams and rivers which the railway intersects, some of which are of considerable magnitude, such as the Stratford viaduct of five arches, each of thirty-six feet span, the Mill-pond bridge of forty-six feet span, Kent's Mill bridge of four arches, and the Abbey River bridge, all of which are over tidal currents, besides numerous other small archways. The Stratford station is erected after the style of a plain Italian villa, fitted up with waiting-rooms, carriage-shedding, engine-house, and repairing workshops for the engines. The depth of the cutting which immediately follows this station varies from ten to twenty feet. The public terminates at Barrack Lane, immediately adjacent to the town of Romford; the total distance is about ten miles and a half, which the trains will accomplish in less than half an hour. The engineer to the line is Mr. Braithwaite, to whom much praise is due for the generally efficient manner in which the works have been executed, and the engineering difficulties (not a few) surmounted.—*Ibid.*

Ibid.

The Oxford Street Experimental Paving.

On Saturday, the 18th ultimo, in accordance with the arrangements made by the Marylebone Vestry, limiting the period of the trial of the respective experimental pavements laid down in Oxford street until the month of May, Mr. Kensett, as chairman of the Paving Committee, laid before the board the state in which each of the experiments was. The following is the result:—On examining the bitumen laid down by the Bastenne and Gaujac Bitumen Company, they found it had stood the test of the severe wear and tear of the vehicles passing that road during the whole winter, without any material alteration. That portion laid down by the Val de Travers Company, which had been studded with stone, had stood, but that portion in which the broken granite had been set in their liquid had totally failed, and must be removed immediately. The Aberdeen granite cubes laid down by the parish had proved to be in most excellent condition; that more particularly which had been set in Claridge's Asphalte was in a state of superior order, and the stones appeared immovable. Robinson's bitumen had been taken up some months since in consequence of having proved a decided failure. The Scotch asphaltum had been repaired once, and had again become so dilapidated as to render the portion of the road which it occupies dangerous. The wooden block pavement, which had been laid down five months since by the

projector, Mr. Stead, had excited the minute attention and admiration of the committee. It appeared, on examination, that the blocks formed a road of a most even surface, and carriages passed over without the slightest noise, and of the twelve inches, the length of the blocks, it was found they had not been diminished one quarter of an inch. Their attention, however, was particularly directed to the bottom of the blocks, which, to the extent of about three-fourths of an inch, appeared discoloured by a blue stain, intimating that the first approach of decay was making its appearance. A considerable division of opinion existed among the committee upon the above appearance being that of decay; they were, however, of an unanimous opinion that a further trial was necessary, in order to enable the vestry to be fairly satisfied as to the durability of the pavement which might ultimately be decided upon, and that any decision ought to be deferred till the autumn. It was ultimately decided in the vestry that the application of a Mr. Geary to lay down a wooden pavement, upon an improved principle, should be referred to the committee, and that the final decision upon the experiments should be deferred to the first Saturday in September. C. E. & Arch. Jour.

Birmingham Railway Signals,

Every station is furnished with an alarum, to give notice of the approach of each train, and to summon the whole of the men to their appointed places. These alarums are so constructed, that a weight is wound up after they have performed their office which prepares them to perform it again. On seeing that the forthcoming train has reached the proper spot, the policeman stationed at them pulls a trigger, and the weight begins to descend, ringing a loud gong-shaped bell by means of internal machinery. Bells are also hung so as, in a few seconds, to collect together the whole of the men belonging to the station, for any required purpose.

The police are placed along the line at distances varying from one to three miles, according as local circumstances rendered it necessary. Each man has his beat and duties defined, and is provided with two signal flags, one of which is red and the other white: the white flag is held out when no obstruction exists; and, on the contrary, the red flag indicates that there is danger, and that the train must not pass the signal till it is ascertained that the cause of danger is removed.

Each policeman, also, is furnished with a revolving signal lamp, to be used after dark; which shows, at the will of the holder, a white light when the line is clear; a green one when it is necessary to use caution, and that the speed of the train be diminished; and a red light, to intimate the necessity of immediately stopping.—*Roscoe's London and Birmingham Railway.* Ibid.

Clifton.—Somersetshire.—Enlargement of the Village. Brunel's Suspension Bridge.

There is, both in the village and out of it, enough going on to show that the building art does not lie idle. There is an evident growth of houses, which, like most of their predecessors, are very superior to the dingy-looking brick fronts in London, which almost stare us out of countenance. They approach more to the first-rate houses in Regent's Park, or in the city of Bath. Indeed, it has been said (*Beauties of England and Wales,*) that the Upper Crescents, particularly the terrace of the largest (which,

together, form so conspicuous a feature,) can hardly be rivalled by any street in England. But from the village let us stroll to the Downs. Here is a series of villas just completed, in the plain Athenian style of architecture; and the grounds too, adjoining, are laid out in a tasteful manner. Not far from this spot, we may see the fruits of all-conquering genius, although they are not yet brought to maturity; we may see how mankind have reached "the highest heaven of invention;" where all around is quiet and solitudinous, but where is here heard the hum of men from the factory at the foot of Leigh Wood, whence the awakening sound goes forth; and it is deeply interesting to watch an immense weight of material for the masonry of the butment of the suspension bridge, traveling up an inclined plane that descends from the summit of the rocks, full 800 feet high. And what a proud memorial of skill, when the iron that has come under the giant grasp of the steam-arm is made subservient to ends so beautiful and so useful! What feelings of admiration and delight will be raised in the breast of the beholder, when he surveys a safe way for millions, or more, stretched from rock to rock high up in the air; beneath which vessels, with their sails spread to catch the breeze, float fearlessly and swiftly for the good of his fellow creatures! How grand, how imposing, it will be, to see one of the greatest triumphs of art achieved and wrought into those bold and lofty rocks, which have been formed by the hand of Nature, and founded upon an immovable basis!—*Frederick Lush, Oct.*, 1838.

Arc. Mag.

Birmingham, Bristol, and Thames Junction, and the Pneumatic Railway.

We understand the patentees of Clegg's Pneumatic Railway have entered into an arrangement with this company to lay down 1¼ mile, on a single way of their line, the necessary apparatus of a tube, &c., to try the experiment with. The road is to be ballasted, and the necessary rails and apparatus laid at the sole cost of the patentees. They are to have eight months from the date of the agreement to complete and prove the experiment. If at the end of that time it succeeds, the railway company are to have the use of the patent gratuitously, paying, of course, the expense the patentees may have been at in laying down the way, if they shall choose to take it. If it does not succeed, the latter are bound to clear all off in eight days after the proof of failure. A more favourable agreement than this to the company cannot be conceived; and in our opinion the directors have acted most wisely in accepting it. If the invention succeed, they secure the benefit of it to the company free of all patentee charges; and if it fail, they lose nothing. In the meantime they will have one line of way to themselves if wanted. So confident, however, are the patentees of success, that they are going, we hear, to the expense of about 14,000*l.* in the experiment. Our wish would be that they may succeed, but we must confess success on the whole length of this line, 2 or 3 miles, would not perfectly convince us of its success on a line of 30 or 100 miles long, for the reasons stated in our Number 41. The experimental way is to be carried up to, and beyond, the crossing of the Great Western line, so as to show the effects of a break in the apparatus. If, indeed, the Directors require it, it must also be continued up to the junction of the Birmingham Railway. A part of the line on which the experiment is about to be tried, has a gradient of forty-four feet per mile.

Rail. Mag.

Preserving Wood by Lime-water.

Sir,—Some years ago I called the attention of the readers of your instructive periodical to Sir Charles Stewart Menteith's (of Closeburn, Dumfrieshire) simple unpatented method of preserving timber; I think it so valuable a process, that it cannot be too often published. It is as follows: after cutting the timber to the size it will be wanted, it is steeped in a pond of lime and water for a fortnight, or more or less time, according to the size of the wood. Sir Charles has now some farm buildings on his estate, the timber in the roofs of which is the common young Scotch fir, but having undergone the lime-water process, it is as sound (after a lapse of forty years) as the day it was put up; the same timber, under ordinary circumstances, and in similar situations, would rot in from three to seven years. The carpenters find, in working the wood thus treated, that the edges of their plane-irons soon become dull; on examination, it is found that the acid contained in the wood is crystallized by combining with the alkali of the lime.

Yours faithfully, ARTHUR TREVELYAN.

Mech. Mag.

D'Harcourt's Patent Artificial Granite Blocks.

The attention of a meeting of the Institute of Civil Engineers having been called to M. D'Harcourt's artificial granite for railway blocks, and other purposes, Mr. Rastrick remarked that he had, about a month ago, laid down blocks of the Scotch Asphalte, two feet square, on a portion of the Southampton Railway. The sleeper was put in while the block was formed. It was usual to bore holes and to fix the chairs by bolts; he had wished to ascertain how far the blocks would stand the driving in of the bolts, without any boring; they bore this without any apparent injury, and he thought these blocks, weighing about 3 3-4 cwt., would answer the purpose better than blocks of other materials. Ibid.

Mechanics' Register.

Daguerre's Photography.

A few days since M. Daguerre exhibited, in one of the rooms attached to the Chamber of Deputies, several specimens of the products of the Daguerreotype. Among them were views of three streets of the capital, the interior of M. Daguerre's atellier, and a group of busts in the collection of the Louvre. The deputies who examined them, and who continued to crowd the room throughout the day, were particularly struck with the marvellous minuteness of detail which these views, and especially those of the streets, exhibited. In one, representing the Pont Marie, all the minutest indentations and divisions of the ground, or the building, the goods lying on the wharf, even the small stones under the water at the edge of the stream, and the different degrees of transparency given to the water, were all shown with the most incredible accuracy. The use of a magnifying glass revealed an infinity of other details quite undistinguishable by the naked eye, and more particularly in the foliage of trees. The antique busts are said to have been rendered by this method with very great beauty

of effect. The chemical substance upon which the light acts, according to M. Daguerre's method, is laid upon sheets of copper, which, for the drawing exhibited on Saturday, were about nine or ten inches by six or seven inches. The expense of such plates M. Daguerre estimates at about 3 fr. 50c. each, but he expects that considerable reductions may be ultimately made in their cost, and that the improvement of his method will render it applicable to other substances not metallic.—*Galignani.* Ibid.

Average Value of the Annual Mineral Product of Cornwall and Devon.

If we estimate the value of the metals annually raised in Great Britain and Ireland, at about 10,597,000*l.*, and consider that of this sum the iron amounts to 8,000,000*l.*, the value of the remaining metals would be 2,597,000*l.*, of which Cornwall and Devon would furnish about 1,340,000*l.*, or more than one-half, leaving 1,257,000*l.* for the value of all the metals, with the exception of iron, raised in other parts of the United Kingdom. The two great metallic products of the district are copper and tin; of the former it yields one-third, and of the latter nine-tenths, of the whole supply of copper and tin furnished by the British Islands and all the countries of the continent of Europe.—*Geological Report*, 1839. Min. Rev.

The Locomotive Engine.

With sufficient coals and water in his manger, this iron horse can carry every day for ten hours, at the rate of sixteen miles an hour, the weight of an army of 21,504 men; whereas a good horse could not, at the same pace, and for the same distance, carry every day more than one man. For eighty miles he can carry the weight of 2688 men at a rate that neither the hare, the antelope, nor the race-horse could keep up with. No journey ever tires him; he is never heard to grumble or hiss but for want of work; the faster he goes the more ravenously he feeds; and for two years he can travel without medicine or surgery. It requires, however, about 2000*l.* a year to support him. By the invention of the locomotive engine, man has surpassed in speed every quadruped on the globe. Quar. Rev.

Fossil Bones.

A collection of fossil bones has been sold during the week by the Messrs. Stevens; the principal purchasers were the British Museum, the College of Surgeons, Professors Buckland and Sedgwick. The prices of the rarer lots were:—Bones of the mastadon: sides of the lower jaw, containing two molars, symphysis perfect, 1*l.* 12*s.*; a portion of the skull, with upper jaw, containing 4 molars, a very fine and perfect specimen, 4*l.*; fragment of the lower jaw, with molar, in fine preservation, 1*l.* 10*s.*; the left ramus of the lower jaw, of gigantic dimensions, with 2 molars, 2*l.*; the right ramus of ditto, with ditto, apparently of the same individual, 2*l.* 2*s.*; the cranium, with sockets for 2 molars, length from occiput to end of socket of tusk, 44 inches, diameter across at orbit, 28 inches, girth at occiput, 91 inches, weight upwards of half a ton, 153*l.* 6*s.* The lower jaws of the young hippopotamus, with the teeth very perfect, 2*l.*; very fine specimen of the lower jaw of a ruminant, 9*l.* 10*s.* Lon. Athen.

LUNAR OCCULTATIONS FOR PHILADELPHIA, DECEMBER, 1839.					Angles reckoned to the right or westward round the circle, assecn in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
12	8	16	Im. λ Aquarii	4	129°	166°
12	9	22	Em.		303	347
12	9	33	Im. 78 "	6	133	178
12	10	34	Em.		293	342
19	17	49	Im. C Tauri	4.5	75	129
19	18	39	Em.		268	317
21	8	21	N. App. ☽ & κ Gemin 4, ☽ North 3.'4			
24	10	7	Im. ε Leonis	4	49	359
24	11	4	Em.		263	211
27	15	4	Im. ♀ Virginis	5.6	22	342
27	16	8	Em.		262	232

Meteorological Observations for June, 1839.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	52	66	29.65	29.65	W.	Moderate.		Cloudy—do.
	2	50	65	.65	.70	E.	do.	.25	Partially cloudy—do.—rain.
	3	54	66	.65	.65	E.N.	do.		Cloudy—clear.
☽	4	56	64	.70	.70	E.	do.		Cloudy—do.
	5	50	58	.65	.66	E.N.W.	do.	1. 5	Rain—cloudy.
	6	49	75	.75	.80	W.	do.		Clear—do.
	7	55	79	.95	30.00	W.	do.		Clear—do.
	8	60	79	30.00	.00	W.	do.		Clear—do.
	9	66	79	29.70	29.70	W.	do.	.25	Cloudy—shower.
⊗	10	68	82	.70	.70	W.	do.		Clear—do.
	11	68	83	.70	.70	W.	do.	.60	Lightly cloudy—shower.
	12	60	75	.80	.85	W.	do.		Clear—do.
	13	64	75	.85	.70	W.	do.	.23	Cloudy—shower—high wind.
	14	60	61	.75	.80	E.	do.	.6	Cloudy—drizzle.
	15	55	61	.80	.80	W.S.	do.		Partially cloudy—clear.
	16	58	73	.65	.70	W.	Brisk.		Clear—flying clouds.
	17	56	69	.80	.86	W.	Moderate.		Cloudy—lightly cloudy.
☾	18	62	73	.80	.70	W.S.	do.	.6	Cloudy—rain.
	19	62	78	.60	.70	W.	do.		Clear—do.
	20	53	70	.80	.80	W.	do.		Lightly cloudy—clear.
	21	64	70	.70	.70	W.	do.		Cloudy—clear.
	22	70	85	.55	.55	W.	Brisk.	.1	Drizzle—clear.
	23	57	76	.75	.80	W.	Moderate.		Clear—do.
	24	56	73	.85	.86	W.	do.	.30	Clear—rain.
	25	56	64	.90	.95	W.	do.		Cloudy—clear.
☺	26	60	74	.95	.95	W.	do.		Clear—do.
	27	62	78	.85	.85	S.E.	do.	.50	Cloudy—rain.
	28	62	72	.65	.65	E.	do.	.5	Rain—clear.
	29	64	74	.70	.80	W.	do.		Clou'y—do.
	30	64	76	.90	.90	W.	do.		Clear—do.
	Mean	59.10	72.43	29.76	29.77			3.36	

	Thermometer.		Barometer.	
Maximum height during the month.	85.	on 22d.	30.00 on 7th & 8th.	
Minimum " "	49.	6th.	29.55	22nd.
Mean	65.765		29.765	

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

OCTOBER, 1839.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.
1	Philadelphia,														
2	Montgomery,														
3	Bucks,	Newtown,	L. H Parsons,	49.90	65.74	52.32	82.	32.	55.99	2/3	26.	42.07	3	30.18	30.1
4	Lehigh,														
5	Northampton,														
6	Monroe,	Stroudsburg,	A. M. Stokes,	43.80	61.72	48.45	75.	25.	51.32	2½	.....	.....	.	29.70	29.6
7	Pike,														
8	Wayne,														
9	Susquehanna,	Silver Lake,	E. Rose,	49.90	63.71	56.19	80.	40.	56.60	.	38.	44.97	.	28.15	28.1
10	Luzerne,														
11	Schuylkill,	Pottsville,	John Porter,	48.34	63.32	51.73	76.	27.	54.46	8⅔	24.	42.43	8	29.46	29.4
12	Berks,	Reading,	C. F. Egelmann,	49.81	62.74	52.62	74.	29.	55.06	.	....	.....	.	29.99	29.8
13	Chester,														
14	Delaware,	Haverford,	Haverford School,	47.47	60.35	51.86	73.	30.	53.23	14⅔	31.	47.50	15	29.73	29.7
15	Lancaster,	Lancaster,	Conservatory of Arts,	49.47	67.07	54.97	80.	32.	57.17	.	30.	47.48	.	29.72	29.6
16	York,	York,	Calvin Mason,	55.79	64.76	54.53	78.	39.	58.36	.	32.	48.53	.	29.75	29.7
17	Lebanon,														
18	Dauphin,														
19	Northumberland,	Northumberland,	Andrew C. Huston,	48.77	61.58	53.40	72.	35.	54.58	.	23.	41.71	.	29.62	29.6
20	Columbia,	Danville.	C. H. Fricke,	.....	.....	.....	.....	.....	.....	.	....	.....	.	29.64	29.6
21	Bradford,														
22	Tioga,														
23	Lycoming,														
24	Union,														
25	Mifflin,	Lewistown,	J. Culbertson, M. D.,	53.76	62.29	58.55	75.	42.	58.20	4⅔	....	.....	.	29.46	29.4
26	Juniata,	Mifflintown,	J. A. Rinkead,	49.98	66.79	53.93	78.	27.	56.90	2½	....	.....	.	29.69	29.5
27	Perry,														
28	Cumberland,	Carlisle,	Prof. W. H. Allen,	47.03	63.35	53.16	77.	28.	54.85	.	27.	43.68	.	29.61	29.5
29	Adams,	Gettysburg,	Prof. M. Jacobs,	46.31	63.47	52.08	76.75	33.50	53.95	.	28.	44.65	.	29.58	29.5
30	Franklin,	Chambersburg,													
31	Huntingdon,														
32	Centre,	Bellefonte,	John Harris,	43.93	60.55	51.04	76.	20.	51.84	3	18.	38.55	9	29.43	29.4
33	Potter,														
34	M'Kean,	Smithport,	Richard Chadwick,	42.81	63.84	47.81	80.	22.	51.49	.	17.	39.61	.	28.29	28.3
35	Clearfield,														
36	Cambria,	Ebensburgh.	Richard Lewis.	49.37	59.84	53.65	73.	33.	54.29	7	....	....	.	28.10	28.0
37	Bedford,														
38	Somerset,														
39	Indiana,	Indiana,	Richard White,	57.16	64.68	60.16	80.	40.	60.67	.	28.	44.55	.	28.75	28.7
40	Jefferson,	Rose Cottage,	C. C. Gaskell,	41.13	62.69	49.94	80.	24.	51.25	⅔	23.	40.32	.	29.13	29.0
41	Warren,														
42	Venango,														
43	Armstrong,														
44	Westmoreland,														
45	Fayette,														
46	Green,														
47	Washington,														
48	Allegheny,														
49	Beaver,														
50	Butler,	Butler,	Jacob Mechling,	46.99	66.23	56.26	80.	31.	59.83	.	...	....	.	....	....
51	Mercer,														
52	Crawford,														
53	Erie,														

LUNAR OCCULTATI
DEC

Day.	H'r.	Min.	Sta
12	8	16	Im. λ Ac
12	9	22	Em.
12	9	33	Im. 78
12	10	34	Em.
19	17	49	Im. C T
19	18	39	Em.
21	8	21	N. App.
24	10	7	Im. ζ Le
24	11	4	Em.
27	15	4	Im. ♀ Vi
27	16	8	Em.

Meteoro

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Bar. Sun rise
				Inch
	1	52	66	29.
	2	50	65	
☽	3	54	66	
	4	56	64	
	5	50	58	
	6	49	75	
	7	55	79	
	8	60	79	30.
	9	66	79	29.
⊗	10	68	82	
	11	68	83	
	12	60	75	
	13	64	75	
	14	60	61	
	15	55	61	
	16	58	73	
	17	56	69	
☾	18	62	73	
	19	62	78	
	20	53	70	
	21	64	70	
	22	70	85	
	23	57	76	
	24	56	73	
	25	56	64	
☹	26	60	74	
	27	62	78	
	28	62	74	
	29	64	74	
	30	64	76	
	Mean	59.10	72.43	29

Maximum height during th
Minimum "
Mean "

Thermometer.

2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.	7, A. M.	2, P. M.
65.74	52.32	82.	32.	55.99	⅔	26.	42.07	3	30.18	30.14
61.72	48.45	75.	25.	51.32	2⅓	.....	.....	.	29.70	29.69
63.71	56.19	80.	40.	56.60	.	38.	44.97	.	28.15	28.16
63.32	51.73	76.	27.	54.46	8⅔	24.	42.45	8	29.46	29.43
62.74	52.62	74.	29.	55.06	.	....	.....	.	29.99	29.88
60.35	51.86	73.	30.	53.23	14⅔	31.	47.50	15	29.73	29.76
67.07	54.97	80.	32.	57.17	.	30.	47.48	.	29.72	29.66
64.76	54.53	78.	39.	58.36	.	32.	48.53	.	29.75	29.73
61.58	53.40	72.	35.	54.58	.	23.	41.71	.	29.62	29.62
.....	.....	.....	.....	.....	.	....	.....	.	29.64	29.67
62.29	58.55	75.	42.	58.20	4⅓	....	.....	.	29.46	29.40
66.79	53.93	78.	27.	56.90	2⅓	....	.....	.	29.69	29.57
63.35	53.16	77.	28.	54.85	.	27.	43.68	.	29.61	29.58
63.47	52.08	76.75	33.50	53.95	.	28.	44.65	.	29.58	29.57
60.55	51.04	76.	20.	51.84	3	18.	38.55	9	29.43	29.44
63.84	47.81	80.	22.	51.49	.	17.	39.61	.	28.29	28.30
59.84	53.65	73.	33.	54.29	7	....	....	.	28.10	28.07
64.68	60.16	80.	40.	60.67	.	28.	44.55	.	28.75	28.74
62.69	49.94	80.	24.	51.25	⅔	23.	40.32	.	29.13	29.07
66.23	56.26	80.	31.	59.83	.	...	....	.	....	....

Barometer.							Weather.							Winds.															Hygrometer.					
7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
30.18	30.14	30.17	30.59	29.47	30.16	$\frac{1}{3}$	13$\frac{1}{3}$	15$\frac{2}{3}$	2	....	....	....	..	2.150	7	.	3$\frac{2}{3}$	.	2$\frac{2}{3}$	.	1$\frac{1}{3}$	.	7$\frac{2}{3}$	.	4$\frac{2}{3}$	.	2	.	2	.	.	.	....	.	.....	....	.	892
29.70	29.69	29 70	30.20	29.33	29.70	3	16$\frac{1}{3}$	10	4$\frac{2}{3}$	....	....	....	..	1.000	2$\frac{1}{3}$	.	3	.	3	.	1$\frac{2}{3}$	.	4$\frac{1}{3}$	.	6$\frac{2}{3}$	.	6$\frac{2}{3}$	.	$\frac{2}{3}$	.	.	2$\frac{2}{3}$	....	.	.....	58.56	22	860
28.15	28.16	28.17	28.50	27.80	28.16	.	16$\frac{1}{3}$	14$\frac{2}{3}$	.	4	....	...	..	0.700	.	.	.	.	.	.	1	.	4	.	10$\frac{2}{3}$	2	6$\frac{1}{3}$	.	7	.	.	.	....	.	.....	....	.	886
29.46	29.43	29.44	29.80	29.10	29.44	8$\frac{2}{3}$	12	10$\frac{1}{3}$	8$\frac{2}{3}$	....	....	....	..	0.860	2$\frac{1}{3}$	.	1$\frac{2}{3}$	.	$\frac{1}{3}$	.	1$\frac{2}{3}$	.	.	.	1	.	2	.	3	.	10	9$\frac{1}{3}$	....	.	.....	....	.	859
29.99	29.88	29.90	31.	29.05	29.92	.	15	16	.	3	....	....	..	1.254	.	.	1$\frac{2}{3}$	.	.	.	3$\frac{1}{3}$	.	$\frac{1}{3}$	.	4	$\frac{2}{3}$	5	.	14$\frac{2}{3}$	.	1$\frac{1}{3}$	.	....	.	.....	....	.	854
29.73	29.76	29.73	30.24	27.87	29.74	12$\frac{2}{3}$	1	9	21	....	....	....	..	....	1$\frac{2}{3}$	1$\frac{2}{3}$	2$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{2}{3}$	.	.	.	2$\frac{2}{3}$	1$\frac{1}{3}$	1$\frac{1}{3}$	1	1$\frac{2}{3}$	$\frac{1}{3}$	$\frac{2}{3}$	14$\frac{2}{3}$	....	.	.....	....	.	884
29.72	29.66	29.67	30.09	29.25	29.68	.	21	10	.	3	....	....	1	1.305	3$\frac{2}{3}$	2$\frac{2}{3}$	1$\frac{1}{3}$	.	5$\frac{1}{3}$	.	1$\frac{2}{3}$	2$\frac{1}{3}$	4$\frac{2}{3}$	2$\frac{1}{3}$	1	1	1$\frac{1}{3}$	.	2$\frac{2}{3}$	1	.	.	51.81	.	.....	58.68	.	865
29.75	29.73	29.75	30.20	29.40	29.74	.	.	.	.	....	....	....	..	0.850	.	.	6$\frac{2}{3}$	.	$\frac{2}{3}$	.	1	.	.	.	2$\frac{1}{3}$	.	3$\frac{2}{3}$	.	16$\frac{1}{3}$	.	.	$\frac{1}{3}$	44.35	.	.....	....	.	856
29.62	29.62	29.60	30.03	29.20	29.61	.	13$\frac{1}{3}$	17$\frac{2}{3}$	.	3	....	....	..	1.492	7$\frac{1}{3}$	.	1	.	1	.	4	$\frac{1}{3}$	5$\frac{2}{3}$	.	$\frac{2}{3}$	.	2$\frac{2}{3}$	.	3	.	5$\frac{1}{3}$	.	....	.	.....	58.87	.	851
29.64	29.67	29.65	30.12	29.23	29.65	5$\frac{1}{3}$	14$\frac{2}{3}$	11	5$\frac{1}{3}$	....	....	....	..	1.336	2	.	.	.	.	.	1$\frac{1}{3}$	.	.	.	2$\frac{1}{3}$	.	$\frac{1}{3}$	.	3	.	15	7	....	.	.....	....	.	1034
29.46	29.40	29.43	29.81	29.10	29.43	3$\frac{2}{3}$	.	.	.	...	....	....	..	....	.	.	3$\frac{2}{3}$	.	.	.	4$\frac{1}{3}$	1	2	.	9$\frac{2}{3}$	.	.	.	3$\frac{2}{3}$	.	.	6$\frac{2}{3}$	....	.	.....	....	.	857
29.69	29.57	29.57	30.60	29.12	29.61	2$\frac{1}{3}$	10	14$\frac{1}{3}$	6$\frac{2}{3}$	....	...	...	..	4.500	.	.	1$\frac{1}{3}$	.	$\frac{1}{3}$	.	5$\frac{1}{3}$	.	.	.	3	.	$\frac{2}{3}$	.	3$\frac{1}{3}$	.	15$\frac{1}{3}$	1$\frac{2}{3}$	....	.	.....	....	.	855
29.61	29.58	29.58	30.	29.19	28.59	.	17	14	.	....	....	....	..	0.824	1	.	1	.	1	.	3	$\frac{1}{3}$	1$\frac{1}{3}$	$\frac{1}{3}$	1	$\frac{1}{3}$	5	.	4$\frac{1}{3}$	.	12$\frac{1}{3}$	.	....	.	.....	....	.	852
29.58	29.57	29.55	29.96	29.19	29.57	.	17	14	.	3	....	....	..	0.825	1$\frac{1}{3}$	1$\frac{1}{3}$	5	.	$\frac{2}{3}$	1$\frac{1}{3}$	5$\frac{1}{3}$	$\frac{2}{3}$	3$\frac{2}{3}$	1	3	3	1$\frac{2}{3}$	$\frac{1}{3}$	2$\frac{1}{3}$	$\frac{1}{3}$	.	.	49.84	.	.....	56.40	.	888
29.43	29.44	29.40	29.80	29.03	29.42	2$\frac{2}{3}$	14$\frac{2}{3}$	13$\frac{2}{3}$	2$\frac{2}{3}$	....	....	....	..	1.054	1$\frac{1}{3}$	.	4$\frac{1}{3}$	.	$\frac{1}{3}$	.	2$\frac{2}{3}$	.	4$\frac{1}{3}$	.	9	$\frac{2}{3}$	1$\frac{2}{3}$	.	3	.	$\frac{1}{3}$	3$\frac{1}{3}$	....	.	.....	....	.	899
28.29	28.30	28.28	28.60	27.92	28.29	.	15$\frac{2}{3}$	15$\frac{1}{3}$	.	..	....	....	..	0.415	1$\frac{1}{3}$	.	$\frac{2}{3}$	.	5	.	4$\frac{1}{3}$	.	$\frac{1}{3}$	.	2$\frac{1}{3}$	.	8$\frac{2}{3}$	.	$\frac{1}{3}$	.	7$\frac{2}{3}$	$\frac{1}{3}$	60.50	4	.....	61.48	.	874
28.10	28.07	28.08	28.40	27.72	28.08	7$\frac{1}{3}$	.	.	.	....	....	...	..	....	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	.	1$\frac{1}{3}$	.	5$\frac{1}{3}$	.	4	.	$\frac{1}{3}$	$\frac{1}{3}$	3$\frac{1}{3}$	2	3	.	3	7$\frac{1}{3}$	....	.	.....	...	.	853
28.75	28.74	28.74	29.10	28.40	28.74	.	21$\frac{1}{3}$	9$\frac{2}{3}$	.	....	....	....	..	0.896	$\frac{1}{3}$	.	2	.	$\frac{1}{3}$	.	6$\frac{1}{3}$	.	.	.	5$\frac{1}{3}$	.	1$\frac{2}{3}$	.	2$\frac{1}{3}$	.	12$\frac{2}{3}$	.	....	.	.....	....	.	867
29.13	29.07	29.07	29.80	28.55	29.09	$\frac{2}{3}$	17$\frac{2}{3}$	12$\frac{2}{3}$	$\frac{2}{3}$	....	...	....	..	0.900	$\frac{1}{3}$	.	$\frac{1}{3}$	.	$\frac{1}{3}$	.	2$\frac{1}{3}$	.	.	.	1$\frac{2}{3}$	$\frac{1}{3}$	1	$\frac{2}{3}$	$\frac{1}{3}$	.	21$\frac{2}{3}$	1$\frac{2}{3}$	54.15	4	....	60.52	4	866
....	....	....	....	....	....	.	25$\frac{1}{3}$	5$\frac{2}{3}$	.	1	....	....	1	....	.	.	3	.	13	.	2	.	.	.	8$\frac{2}{3}$	.	4	.	$\frac{1}{3}$	.	.	.	....	.	....	....	.	864

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